A GOVERNOR'S CONFERENCE ON

Protecting and Developing a Valuable Natural Resource

Sponsored by the Department of Energy and Natural Resources

PROCEEDINGS

September 26 and 27, 1985
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A Governor's Conference
on
Lake Michigan—Illinois' GREAT Lake:

Protecting and Developing a Valuable Natural Resource

Proceedings of the Fourteenth Annual ENR Conference
September 26 and 27, 1985
Chicago, Illinois

James R. Thompson, Governor
State of Illinois

Don Etchison, Director
Illinois Department of
Energy and Natural Resources

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	Prior to July, 1982	After July, 1982
Air Quality	- Green	Green
Water	- Blue	Blue
Environmental Health	- White	Grey
Solid and Hazardous Waste	- White	Olive
Economic Impact Study	- Buff	Brown
Noise Management	- Buff	Orange
Energy	- Cherry	Red
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Some of the materials contained in this document were revised and edited by ENR Information Services staff. Any errors or deletions are unintentional.

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DON ETCHISON
DIRECTOR

FOREWORD

If there is any truth to the saying, "Nothing great was ever achieved without enthusiasm," then great things must surely come from the September 1985 Governor's Conference on Illinois' Great Lake -- Lake Michigan.

The remarkable enthusiasm shown by the 300 Conference participants and guests concerning the activity, controversy and questions centering around the Great Lakes will long be a high point for me as the Director of the Illinois Department of Energy and Natural Resources.

Well versed speakers and panelists from government, the private sector and academia provided a candid exchange of ideas necessary for all of us to fully appreciate the significance of, and our dependence upon, the Great Lakes as a source of water, recreation, fishing, transportation and natural beauty.

A multi-talented coalition of Great Lakes specialists taught us about past, present and future dangers to these inland seas. Also, we were challenged and encouraged to learn about the enlightened approaches currently being taken to eliminate these threats.

Prudent Great Lakes management efforts and an efficient scientific and political support system to improve these efforts is the clear message contained in the following Conference proceedings.

As you read through the papers presented by our scientists and political leaders, keep in mind that Great Lakes' water is international in nature. It flows into and around the provinces and states of Canada and the United States, and necessitates a common bond in protecting and improving our Great Lakes.

As Illinois Governor James Thompson and Indiana Governor Robert Orr both noted in their Conference speeches, our economies and the quality of life of our citizens and future generations depend on the positive action we are taking -- and need to take in the future -- to protect and preserve the Lakes.

"Protecting and Developing a Valuable Natural Resource" was intended to be more than just a conference theme -- it was a commitment to the future of one of the world's most valuable and beautiful natural resources -- the Great Lakes.

OPENING SESSION

KEYNOTE ADDRESS

HONORABLE JAMES R. THOMPSON
GOVERNOR
OF
ILLINOIS

JAMES R. THOMPSON

GOVERNOR, STATE OF ILLINOIS

Jim Thompson is serving his third term in the Office of the Governor. He governs the fifth largest state in the union with a population of 11.4 million people and a budget that totals $19 billion.

Gov. Thompson is chairman of the Council of Great Lakes Governors. His administration has demonstrated a continuing commitment to managing the Great Lakes states' resources--both natural and economic. He is past chairman of both the National Governors' Association and the Midwest Governors' Association.

Regarding water resources management, Gov. Thompson has successfully achieved a modification of the U.S. Supreme Court's decree on allocation of Lake Michigan water, enabling an additional 1.5 million people to use this water. Also, a program of regulating allocation of this water to 198 municipalities and local units of government was implemented.

Gov. Thompson has vigorously supported the Midwest Governors' Association's efforts to retain Great Lakes water as a midwest resource and to prevent flow of that resource to the Sunbelt.

Under his administration, the Lake Michigan Shore Protection Study, which identifies major shoreline erosion problems and recommends remedial action, was completed. The study's 1980 report resulted in a simplified permit process for breakwaters and other shoreline protection construction and the development of a plan to protect Illinois Beach State Park.

Gov. Thompson was also responsible for development of a Water Conservation Program, which includes technical assistance to local governments and industry groups, and a Water Quality Management Plan, to prevent water pollution.

The Build Illinois initiative, introduced by Gov. Thompson in 1985, includes proposed spending of $260 million over a five-year period to upgrade sewage treatment plants in Illinois. His environmental record also includes funding for cleaning up hazardous waste disposal sites which pose a severe threat to ground and surface water supplies.

Gov. Thompson is an attorney with a degree from Northwestern University Law School. He served as United States Attorney for the northern district of Illinois from 1971 until his election in 1975. Previously, he was an associate professor at Northwestern. He earlier served as a prosecutor in the Cook County State's Attorney's office.

AN AGENDA FOR PROTECTING AND DEVELOPING THE GREAT LAKES

HONORABLE JAMES R. THOMPSON
GOVERNOR OF ILLINOIS
CHAIRMAN OF THE COUNCIL OF GREAT LAKES GOVERNORS

We meet only a few blocks from one of the world's greatest resources -- Lake Michigan. To a large extent it has helped develop the character of this city and its reputation as one of the great cities of the world. It would, in fact, be difficult to imagine Chicago without that shining blue water standing off its eastern flank.

This group as well as any other understands the vital role that water plays in almost every aspect of our lives -- day in and day out -- at home, at work and at play. Each of you realizes the value of having an abundance of water available to us.

And, concomitantly, you recognize the problems facing those who lack adequate water -- and those who have allowed their water supply to dry up or die through misuse or contamination.

Before I start sounding too parochial about our Great Lake here in Illinois, I will reluctantly admit that Lake Michigan is not just Illinois' lake -- but also Indiana's and Michigan's and Wisconsin's. And I will readily admit that we share common concerns and common goals when it comes to issues dealing specifically with Lake Michigan.

Perhaps the best way to indicate how important Lake Michigan is to Illinois is to point out that nearly five million Illinoisans -- almost half our population -- depend on the lake for their basic water supply - for drinking, cooking, bathing and all the other seemingly mundane but truly essential functions of daily life.

A variety of vital Great Lakes water issues face this community today as we convene to discuss and to share information about Illinois "Great Lake" -- Lake Michigan.

Water quality is a key factor in finding the right formula for a safe and sensible policy on Lake Michigan, and each of the Great Lakes and water quantity is an equally important element in that equation.

With that in mind, we must continue to make progress on improving and protecting the water quality and shoreline of Lake Michigan, as this lake serves important recreational and human needs, including providing water for public water supplies, habitat for commercial fisheries and beaches for public and private recreational boating.

As a region, and in concert with our northern neighbors, we must continue to safeguard this water resource from inefficient and excessive consumption and the threat of out-of-region diversions.

And we also can do more to promote tourism along the Great Lake. Here in Illinois we have begun the development of a marina complex at Illinois Beach State Park in Zion and the development of Navy Pier in Chicago.

It wasn't that long ago that some very serious problems faced this lake. In the late 1960s, a wave of pollution struck our lakeshore. Thousands of dead fish were washed ashore and beaches had to be closed. But the public and government reacted swiftly to the call to "save our lake".

Fortunately, the public and private sectors were able to unite on initiatives to mitigate pollution in Lake Michigan. Specific, stringent water quality standards were established, including a no discharge policy along the Cook County shoreline. And an aggressive water conservation program was set up to ensure the efficient use of Lake Michigan water and to balance competing needs.

The State of Illinois, in conjunction with federal and local governments, has invested billions of dollars into construction and modernizations of wastewater transport and treatment facilities. This investment has improved the quality of waters that flow downstate and has prevented most sewer overflows from reaching Lake Michigan.

The results of those initiatives are now in, and they are impressive. Water quality showed a 92 percent improvement between 1972 and 1982, based on a pattern of decreasing levels of nutrients, bacteria and other standard indications.

By 1982, all 63 miles of shoreline either supported or partially supported the lake's designated uses. Swimming conditions have improved greatly and beach closings are rare. Although there still is some concern about toxic levels in edible fish, the concentration of substances such as PCBs and DDT in fish also has been declining over the last ten years.

In another pollution matter, state lawyers are currently poring over the details of the ruling this week concerning the blockage of the U.S. EPA's efforts to clean up the PCBs from the Waukegan Harbor. We will determine from that whether there is a state role in the cleanup process.

Besides pollution, we in Illinois have also focused our attention on the issue of out-of-region diversion of our water. While it is important for us to work together to improve water quality, we must also safeguard water quantity not only in Lake Michigan, but also in the other lakes.

Illinois has been a leader in supporting regional efforts to improve and conserve Great Lakes water, and to protect it from the threat of out-of-region diversions. We adopted legislation last year prohibiting diversions of Great Lakes water from the state without the concurrence of the other lakes states and the International Joint Commission.

Illinois is also supportive of federal legislation authorizing the Great Lakes states to act in concert with our northern neighbors on vital Great Lakes water issues.

And, in order for Illinois to be in complete compliance with the Great Lakes, charter, which charter members signed earlier this year, I am today signing Senate Bill 796.

That bill expands the Illinois Department of Transportation's Division of Water Resources authority to regulate consumption of Lake Michigan basin water and authorizes the Department to consult on my behalf with the Canadian provinces of Ontario and Quebec on issues relating to the flow and level of Lake Michigan.

The State of Illinois also is keenly interested in promoting the tourism potential of Lake Michigan. Perhaps the most dramatic tourism project being undertaken by the state in cooperation with private developers is the construction of the marina complex at Illinois Beach State Park in Zion, Illinois.

When this marina is completed in 1992, it will be the largest inland marina east of California. The state has already invested $8 million in the marina, and I have identified this project as a high priority for further state funding.

I consider this to be a prime example of the kind of public-private sector partnership that is the heart of this adminstration's "Build Illinois" program that is designed to redevelop our state's infrastructure and make our state even more attractive as a place to live and work.

In Chicago, Navy Pier is a prominent landmark that must be restored for public use as a visible sign of our pride in Illinois history and our commitment to insightful economic development. Four hundred thousand dollars in state funds are available to study the feasibility of developing the pier and surrounding area as a state park, and my administration stands ready to work with the city of the National Park Service, or both, to restore the pier to its former grandeur.

Next year, the Illinois Department of Conservation will release a strategic fish management plan that will ensure the future of sport fishing on Lake Michigan through the coordinated efforts of state and federal agencies and the Great Lakes fisheries commission. Sport fishing is a major tourist industry representing a $100 million a year activity.

However, our efforts to develop Lake Michigan's potential for tourism will be set back significantly if we do not work together to find a solution to the problem of shoreline damage from high lake levels.

We recognize that shoreline damage is a major issue, not only for Illinois residents living along Lake Michigan, but also for those along the other Great Lakes. I will ask the Illinois Department of Energy and Natural Resources and the state's scientific surveys to recommend options for resolving this issue.

Until those recommendations are prepared, private landowners along the lake can continue to seek technical assistance from the Illinois Department of Transportation on ways to prevent shoreline damage to their property.

We in Illinois believe that Lake Michigan is a treasure to be protected for future generations not only in Illinois, but throughout the nation. Without a cooperative effort among all of the states and the provinces of Canada, our grandchildren will not be able to enjoy this Great Lake as we have.

I'd like to express my admiration for the work done by all of you in strengthening the regional identity of the Great Lakes basin, for helping out in Washington and Ottawa, and for cooperating in our joint efforts to protect and enhance the Great Lakes. That respect is held for those of you in attendance, and for all of our friends and associates who could not come here today.

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thompson

GENERAL SESSION ON WATER QUALITY

ORIE L. LOUCKS

HOLCOMB RESEARCH INSTITUTE
BUTLER UNIVERSITY

Orie L. Loucks became director of the Holcomb Research Institute in 1983. He is also a member of the National Academy of Sciences' Board on Water Science and Technology and is the U.S. co-chair of the Joint Committee of the National Academy of Sciences and the Canadian Royal Academy to Review Progress Since the 1978 Water Quality Agreement.

In 1978, Dr. Loucks joined The Institute of Ecology (TIE) in Indianapolis as science director and headed a series of studies concerning the regional effects of air pollutants and acidic deposition on midwest ecosystems. In 1982, TIE transferred its research programs to the Holcomb Research Institute at Butler University and moved its headquarters to Washington, D.C.

Prior to joining TIE, he served from 1976 to 1978 as director of the Center of Biotic Systems in the Institute for Environmental Studies, University of Wisconsin, and as professor of botany. During that time he also headed an inter-disciplinary study of environmental impacts from a large coal-fired generating station in central Wisconsin.

As part of the U.S. contribution to the International Biological Program, Dr. Loucks headed an inter-disciplinary watershed study of the Lake Wingra Basin from 1969 to 1973. During that time, he coordinated the research of 13 disciplinary units in four institutions. From 1955 to 1962, he was a research officer for the Canada Department of Forestry and then joined the department of botany at the University of Wisconsin.

Dr. Loucks' training includes a bachelor of science in forestry from the University of Toronto in 1953, a master's in forestry in 1955, also from the University of Toronto, and a doctorate in botany from the University of Wisconsin-Madison in 1960. Since 1957 Dr. Loucks has authored or co-authored more than 175 journal articles, book chapters, and other reports.

NICHOLAS J. MELAS

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

Nicholas Melas, president of the Metropolitan Sanitary District of Greater Chicago, has been a Sanitary District commissioner since 1962. He has served as chairman of the finance, the labor and industrial relations, and real estate committees. He was elected vice president of the district in 1971 and elected president in 1975.

Mr. Melas has played a major role in the district's financial management, has led the development of the Chicago Area Floodwater Management Plans, and has fostered the expansion of the district's seven treatment plants and the construction of the Deep Tunnel project.

He is a member of the Chicago Public Building Commission, a member of the American Association for the Advancement of Science, and past member of the Northeastern Illinois Planning Commission and board of trustees of the Chicago College of Osteopathic Medicine.

A veteran of World War II, he was awarded the Purple Heart and Bronze Star medals.

DAVID C. VILLENEUVE

HEALTH PROTECTION BRANCH
HEALTH AND WELFARE, CANADA

David C. Villeneuve has been employed since 1964 by the Health Protection Branch in Canada where he has conducted research on the toxicological effects of environmental contaminants including PCBs, pesticides and industrial chemicals. Dr. Villeneuve currently heads a toxicology research section in the Health Protection Branch.

He also serves as a member of the Water Quality Board for the International Joint Commission and is a member of the Federal-Provincial Working Group on Drinking Water. Dr. Villeneuve has authored or co-authored more than 125 scientific publications.

He received his bachelor's and master's degrees from the University of Toronto where he majored in food chemistry and received a doctorate from McGill University in agricultural chemistry.

MARLENE EVANS

GREAT LAKES RESEARCH DIVISION
THE UNIVERSITY OF MICHIGAN

Marlene Evans is an associate research scientist in the Great Lakes research division at the University of Michigan. She has spent several years investigating zooplankton ecology in the Great Lakes. Current research activities include the study of the role of *Mysis relicta* in the transport of PCBs and other toxic substances through the Lake Michigan ecosystem; the evaluation of long-term trends in zooplankton populations in southeastern Lake Michigan as affected by changes in fish populations, water quality, and phytoplankton community structure; and an investigation of zooplankton and benthic drift in the St. Mary's River.

Dr. Evans served as president of the International Association for Great Lakes Research and remains active with that association. She is a member of the Science Advisory Board of the International Joint Commission and chairperson of the Ecological Considerations Committee and the Health of Aquatic Communities Task Force. She was also a convenor of a recent symposium and workshop held at the American Society of Limnology and Oceanography meeting on "The Effects of Persistent Toxic Substances on the Health of Great Lakes Communities".

Dr. Evans obtained her doctorate degree at the University of British Columbia in oceanography and zoology.

DAVID N. EDGINGTON

GREAT LAKES RESEARCH FACILITY
UNIVERSITY OF WISCONSIN

David N. Edgington is director of the University of Wisconsin's Center for Great Lakes Studies/Great Lakes Research Facility as well as a professor of geological sciences at UW-Milwaukee. He has served in these capacities since 1979.

Dr. Edgington's research interests revolve around the application of state-of-the-art chemical and analytical techniques to environmental problems, in particular the use of measurements of natural and man-made radionuclides to the studies of limnological and oceanographic processes such as water residence time, biological interactions and sedimentation. His major research activities center around the investigation of processes at the sediment/water and soil/water interfaces related to the fate of pollutants in the Great Lakes region and studies of the behavior of the transuranic elements in the aquatic environment. Dr. Edgington has published numerous articles on this research.

Prior to joining the University of Wisconsin-Milwaukee, Dr. Edgington was with Argonne National Laboratory from 1962 to 1979, where he served as head of the ecological sciences section and scientist in the radiation and environmental research division. Before joining Argonne, he had a post-doctoral appointment in the department of chemistry at Northwestern University and was an assistant experimental officer, Atomic Energy Research Establishment, Hawell, England.

Dr. Edgington currently is a member of the International Atomic Energy Association Coordinated Research Program for Transuranic Elements in the Oceans and a member of the National Council on Radiological Protection committee's task group on identification and evaluation of environmental models of dose for discharges of radioactivity to surface waters.

He is also a member of the Chemical Society of London, the International Association of Great Lakes Research, the American Society of Limnology and Oceanography, and the Geochemical Society.

He received a B.A. and B.Sc., in 1957 and 1958 respectively, from St. Catherine's College, University of Oxford, England and a doctorate in chemistry in 1960 at St. Catherine's College, University of Oxford.

PROGRESS SINCE THE 1978 WATER QUALITY AGREEMENT AND PROBLEMS THAT MUST STILL BE ADDRESSED

DR. ORIE L. LOUCKS, DIRECTOR
HOLCOMB RESEARCH INSTITUTE
BUTLER UNIVERSITY; CHAIRMAN,
JOINT COMMITTEE OF THE NATIONAL ACADEMY OF SCIENCES
AND THE CANADIAN ROYAL ACADEMY TO REVIEW PROGRESS
SINCE THE 1978 WATER QUALITY AGREEMENT

It is quite opportune that Governor Thompson has taken the initiative of sponsoring a conference on Lake Michigan this autumn. There are continuing changes in the Lake, some for the better and some not, but one has a sense that the four states sharing this lake are coming to embrace more and more steps wherein we can work together for improvements. The benefits that should be ours simply by living near the Great Lakes, and Lake Michigan in particular, are worth a special effort in protection and conservation.

However, the water levels are certainly high, perhaps to the point of distracting us from other issues. In addition, long-term contamination problems still need our attention if we are to complete the agenda we have embarked on jointly with other states, and with Canada in 1978. It is my hope, as it is also Governor Thompson's, that this conference will serve to remind us not just of the progress we have made, which is substantial, but that it will remind us also of the considerable work that remains to be done to find the best way to proceed.

Over the past year I have been privileged to serve as the U.S. co-chair of the joint study, through the National Research Council/National Academy of Sciences and the Royal Society of Canada, to evaluate progress under the 1978 Great Lakes Water Quality Agreement. However, the report of the NRC/RSC is still in review, and will not be released publicly until December. Therefore, I cannot give you a preview of what is in the report; key points are still susceptible to change. Instead, I propose to highlight some of the more significant findings already in the public record--findings that served as important sources for the committee in carrying out its study. Some of these findings may already be familiar to you, but perhaps the particular combination of findings that I highlight will serve to remind us of what has been working well, as well as our obligations to finish a job so recently started.

As you all know, Lake Michigan has an unusual status within the framework of the International Joint Commission and the Great Lakes Water Quality Agreement between the United States and Canada. The first Water Quality Agreement, signed in 1972, was concerned principally with control of high loadings of nutrients (nitrogen and phosphorous) being released into the lower lakes, Lake Erie and Lake Ontario. The serious state of eutrophication was viewed as having diminished the recreational and commercial values of these two lakes. The 1972 Agreement led to the expectation of recovery, an expectation that substantially materialized within a decade after the Agreement was signed.

In the course of implementing the 1972 Agreement, however, it was clear that the laws and regulations being used to implement it were the statutes of the United States and of Canada that mandated control of eutrophication throughout both countries. Programs to reduce phosphorous inputs to all fresh waters in the United States, including Lake Michigan, and other regulations terminating the registration and use of DDT, and limiting the industrial uses of PCBs, also became the law of the land. Their implementation came with the expectation of benefits to Lake Michigan in the form of reduced concentrations of these toxic substances in the fishery.

By 1978 two important new considerations had emerged. First, it became clear that additional programs for nutrient abatement were needed, at least locally, and that control of toxic substances was needed in all of the Great Lakes. These findings included the so-called "upper lakes": Lake Superior, Lake Michigan and Lake Huron. It was also clear that the legislation and regulations needed to achieve these goals would be the same for fresh waters throughout the United States, as for the boundary waters between the U.S. and Canada. Therefore, the question of whether Lake Michigan should continue to stand outside the binational Water Quality Agreement (because the Lake is surrounded by U.S. territory) became moot. The U.S. programs would cover Lake Michigan anyway; the 1978 Agreement was therefore accepted as a means of coordinating among the four states involved. This was an important step toward region-wide resource protection.

A second major conceptual step also emerged in the 1978 Agreement. The statement of purpose mandates that the cooperating parties' goal is to "restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystems." This goal goes far beyond the limited objectives of the 1972 Agreement, and joins the four-state area around Lake Michigan with other states in this region, and with the Province of Ontario, in a mutually-agreed upon approach to protecting and enhancing the water quality of the entire Great Lakes Basin. Parenthetically, one should note that Great Lakes water levels and diversions are not technically under the Great Lakes Quality Agreement, except to the extent that water flows are central to ecosystem functioning at the whole-basin level.

I came to the National Research Council/Royal Society review of the Water Quality Agreement as a comparative outsider with regard to details of the Great Lakes programs over the previous fifteen years. It was, therefore, interesting for me to find the extent to which the most serious problems of Lake Michgan had been addressed by the legislation of the early 1970s to control both nutrients and toxic chemicals. However, problems with respect to "hotspots" around the lakes were still serious in 1977 and 1978. There were recognized risks to public health, and these concerns, as well as possible impairment of the ecosystem, became important goals of the 1978 Agreement. Thus, the major objective of the 1978 Agreement came to be reduction in the releases of toxic substances to the lakes. The goal was that "the discharge of any or all persistent toxic substances be virtually eliminated." Also noted for the first time in the 1978 Agreement was the potential role of volatilization of toxic substances from the adjacent land, a release that could be transported to areas such as the lakes, even as

remote as Lake Superior. Thus, the potential role for atmospheric transport and washout of substances originating outside the Great Lakes Basin came to be recognized as a risk to resources within the Basin.

Programs to "virtually eliminate" the discharge of persistent toxic substances were ambitious indeed. However, they were agreed to by the two countries, and implicitly by the cooperating states and provinces. How well have we done? A reading of the Water Quality Board reports and of the Biennial reports of the International Joint Commission, while reflecting progress, is not altogether reassuring. First, there were troubling examinations of whether the concept of the "limited use zone" provided for in the 1978 Agreement was, in fact, to be understood as a quasi-license for continuing an elevated level of discharges in heavily industrialized areas. This seems to have been the understanding in Canada, but legal challenges in the United States indicated that it was unconstitutional and inapplicable. The binational Boards came to use the term "area of concern," which is not provided for in the Agreement, but does have the magnificent quality of being both descriptive and potentially prescriptive, in the sense that these areas remain on the agenda for possible action. Progress to date, however, has been limited to surveillance of the situation and to studies of what one might do. In the past two to three years, quite significant studies have been carried on in several important areas of concern around Lake Michigan, particularly in the Fox River/Green Bay area in Wisconsin and in the Grand Calumet River area of Indiana.

The most important measure of accomplishment may be whether we have evidence now for a greater sense of security in the use of lake water for drinking and swimming, or in consuming the products of the lake, particularly the fishery. Concentrations of persistent toxics in the water are almost beyond detection, and often are variable from one point to another within the lake. Thus, both the resource status and the risks to the public are probably best expressed by sampling among species at the top of the food chain, i.e., in the predator fish or in birds that eat the fish. In the case of the Great Lakes Basin, the most readily available species reflecting biomagnification of toxic substances to the top of the food chain has proven to be the eggs of the Herring gull. This species occurs throughout the Great Lakes Basin in considerable numbers, and gull populations on certain islands remote from the land area are closely associated with the food chain of the open lake around them.

The results of eight years of monitoring are summarized in Figures 1 and 2. Shown here are trends for two toxic complexes; total PCB's and dieldrin in the eggs of Herring gulls from islands in Lake Superior, Lake Huron, Lake Erie, and Lake Ontario. These data come from the 1985 Water Quality Board Report where they had been made available by the Canadian government. A few samplings of gull's eggs have been carried out in Lake Michigan, but these samplings had been irregular and cannot be used for to the long-period averaging shown here.

What is evident from these figures is that the downtrend in concentrations of PCBs and dieldrin in gull's eggs ended about 1979, the consequence of actions

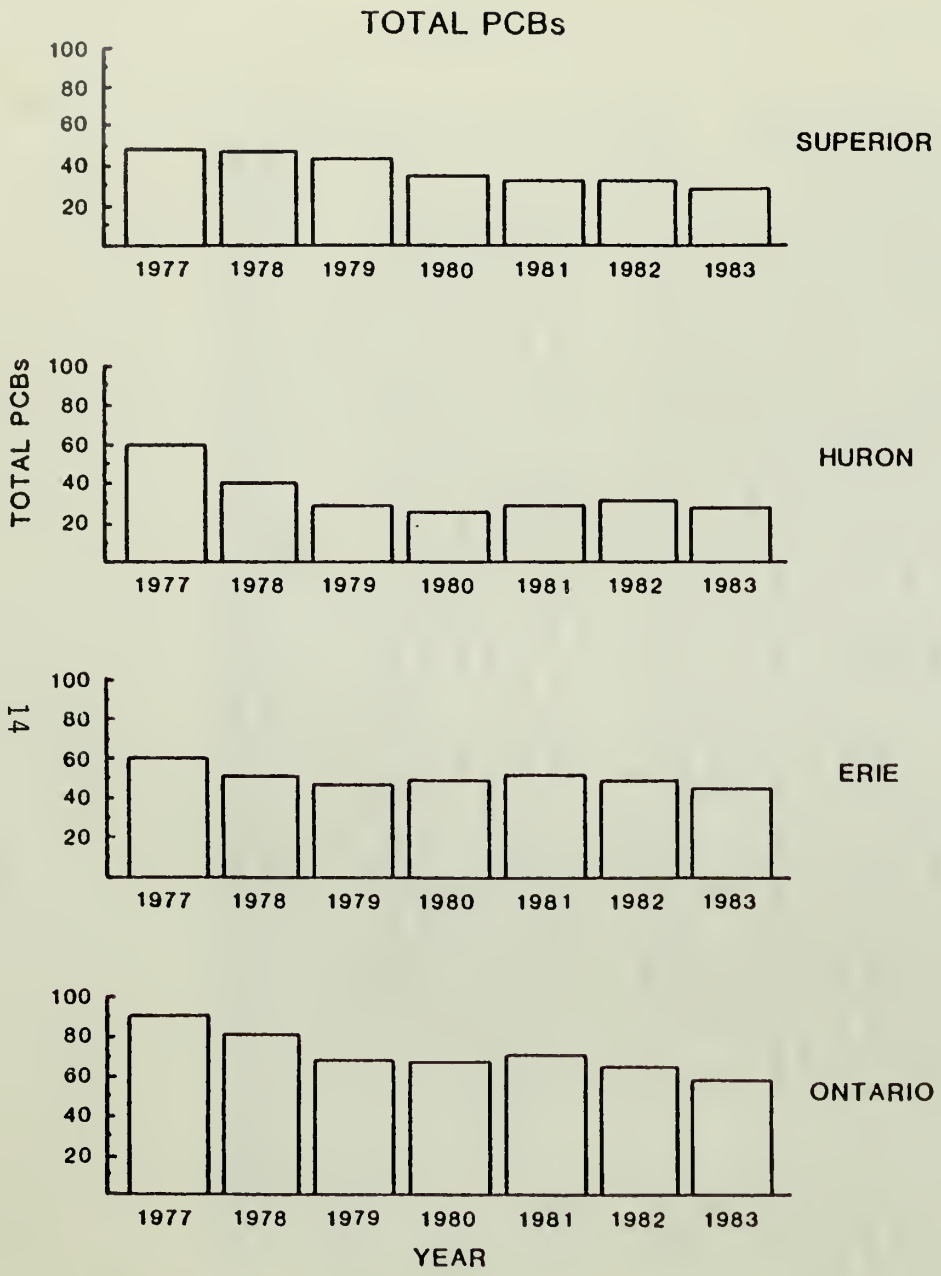

Figure 1. Three-year centrally-weighted running average concentrations of PCBs in Herring gull eggs from two populations on each of the four border lakes. (Data from the Canadian Wildlife Service presented in the 1985 Water Quality Board Report.)

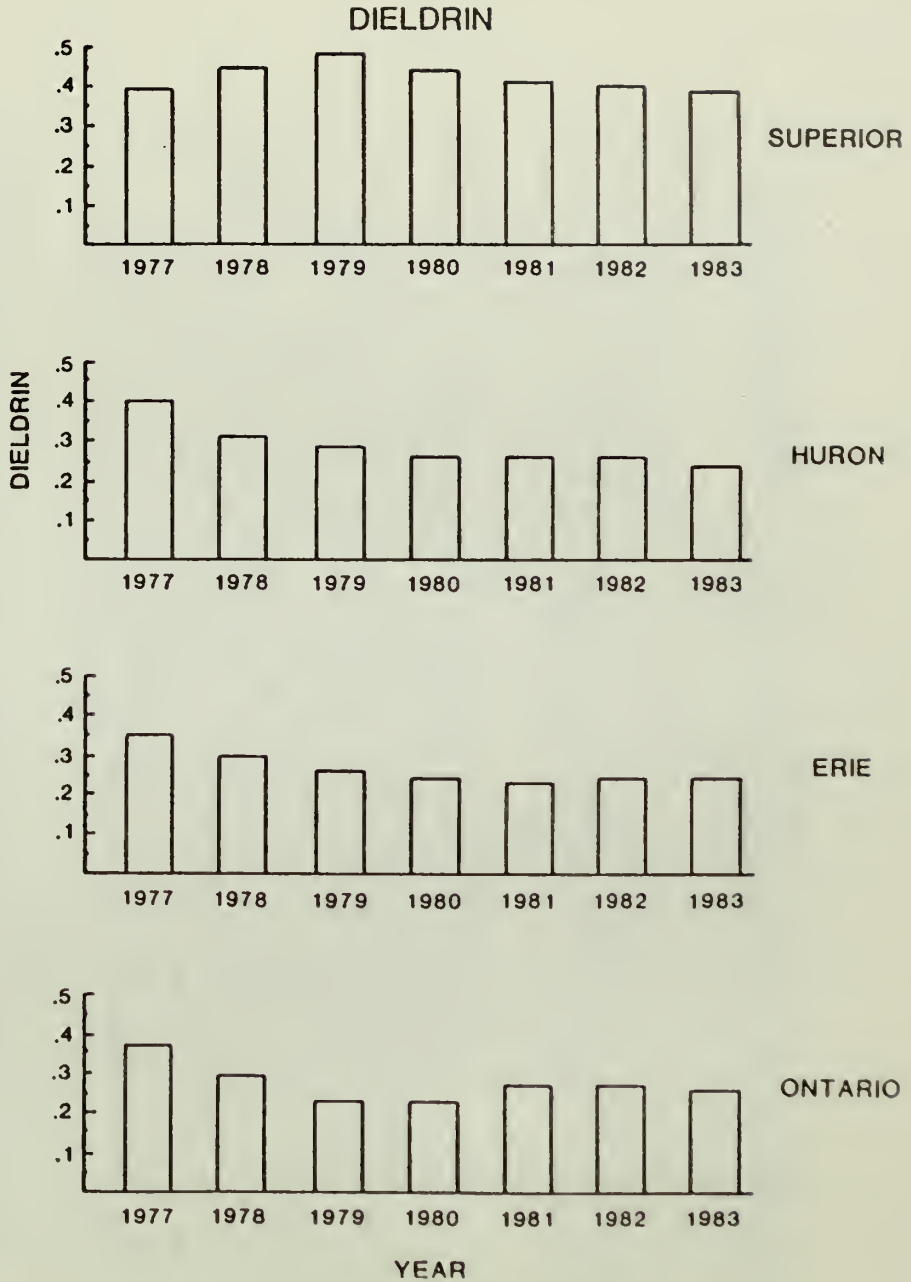

Figure 2. Three-year centrally-weighted running average concentrations of total dieldrin (mg/kg wet weight) in Herring gull eggs from two populations on each of the four border lakes. (Data from the Canadian Wildlife Service presented in the 1985 Water Quality Board Report.)

taken to eliminate the use of these products some eight years earlier. For most of the period since the 1978 Water Quality Agreement there has been very little trend downward, except possibly for PCBs in Lake Superior. The data available for Lake Michigan show that when both the north and south end of the lake are averaged, the results are roughly similar to those of Lake Huron. Since we know that real reduction in releases of toxic substances to these lakes can result in decreased concentrations at the top of the food chain, as is evident during the 1970s, one has to conclude that present loadings are not being reduced by the amounts anticipated under the 1978 Agreement. The results also indicate a remarkable averaging upward in the concentrations in Lake Superior, in comparison to known local sources, and an apparent effect from cumulative loading down the chain of lakes to Lakes Erie and Ontario where the highest concentrations of PCBS are observed.

Why has there been so little progress in the abatement of toxic substances? The answers are apparent from a careful reading of the reports of the Water Quality Board, the Science Revisory Board and the Biennal reports of the International Joint Commission. What one finds is that there were many more sources of toxic substances for all of the Great Lakes than the 1978 Agreement recognized, and each of these sources seems to have been larger than might have been expected. The runoff of toxic substances from agricultural lands and industrial sites is now known to be significant. The leakage of toxic substances from contaminated groundwater into streams or shoreline areas also is now known to be significant, more so in Lake Ontario than in some of the other lakes, but it cannot be discounted anywhere. The resuspension of toxic substances from contaminated sediments, both by physical processes and by biological activity, is contributing to the mobility of contaminants throughout the large-lake systems. Finally, we know much more now about the release of toxic substances from the surface of the land and the surface of the lake into the atmosphere, and the subsequent transport and redeposition in other lakes of the Great Lakes Basin. Of particular importance is the fact that an estimated 85 percent of all the toxic substances deposited on Lake Superior arrives by washout processes, and an unknown portion of this may have originated by volatilization from Lake Superior itself.

Accordingly, the reports of the joint institutions under the U.S./Canada Agreement - the two Boards and the Commission itself - have been urging in the strongest language possible that the two governments and the various state and provincial jurisdictions embark on a more comprehensive approach to managing all sources of persistent contamination reaching the lake, even from outside the Basin. One part of this is the recommendations of the IJC for a Comprehensive Toxic Substances Management Strategy for the entire Basin. What would be involved? The most elementary part would be to stop shuffling wastes with minimal records from their site of origin, to other sites within the Basin where the safety of disposal may be uncertain.

One must also deal with the wastes coming here from outside the Basin by land, as well as the transport of toxic emissions into the Basin by atmospheric processes. Equally important, the joint institutions are making strong recommendations that there should be programs to control the redistribution through the biota of in-place pollutants at the areas of concern. We seem to be facing scientific and political problems that go beyond the protection instruments of the present Agreement.

There are also other high priorities for research and remedial action now evident in the reports of the Boards under the Agreement. There is a need to sustain the nutrient control programs--N and P. Secondly, there is an urgent need for consensus on a concerted action regarding the priority chemicals for control action. Thirdly, we need to determine the inputs of toxic substances from all sources; from surface runoff, from groundwater, from atmospheric washout, and from end-of-pipe municipal and industrial discharges. Throughout these studies, one should be prepared to take remedial action to control important sources just as we control any other "area-wide" source problem. All of these suggestions imply additional research to advance our understanding of linked relationships within the Basin and its functioning as an ecosystem. Last, but not least, we also need to learn to accept the idiosyncracies of each lake and its management needs.

Who are the recommendations of the joint Boards under the Agreement addressed to? There are really three main audiences. One is the audience represented by the two national governments to whom the IJC reports, Canada and the United States, and the associated legislative institutions in each country. A second is the various state and provincial governments that, for the most part, have the local authority to take management and control actions, but that often lack the financial capabilities to do so or to enforce the regulations. Finally, the recommendations are also addressed to the general public, who ultimately must bear the cost and determine the priorities as to whether tax monies will be allocated for the rehabilitation of our Great Lakes resources or for other public goals.

The examination of these priorities, the emerging new risks and new opportunities for the Great Lakes is what this conference is about. I look forward to seeing the many perspectives that will be presented and proposals for further, action-oriented programs.

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WATER QUALITY BENEFITS TO LAKE MICHIGAN FROM ILLINOIS DIVERSION

HONORABLE NICHOLAS J. MELAS, PRESIDENT
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My topic today is the contribution that the Metropolitan Sanitary District's diversion has made to the quality of the water of Lake Michigan. It is roughly going to cover three principal points.

First is the era back around the turn of the century with the reversal of the Chicago River and the benefits that were provided to the quality of Lake Michigan.

Then, the most recent development, which is the opening of the Deep Tunnel Project or the Tunnel and Reservoir Project, to eliminate the occasional backflows of combined sewage (polluted mixture of rain water and sewage) into Lake Michigan.

And the third point that I will discuss will be the effects of our Industrial Waste Ordinance, which was referred to briefly by the Governor this morning when he mentioned that there are no discharges--no industrial discharges--along the entire Cook County shore of Lake Michigan from Lake County, Illinois, all the way down to the Indiana line.

There is a 47,500 cubic feet per second natural flow from Lake Michigan into Lake Huron. And to concentrate our attention to the lower basin, down at the Chicago, the waterway discharge at present is 3,200 cubic feet per second. That is the amount that has been mandated by the Supreme Court in its decision in the '20s and '30s, and that is the total amount of diversion that is taken out of Lake Michigan through the Illinois waterway.

To concentrate on the first point, the reversal of the Chicago River. The Chicago River was not a large river and it flowed into Lake Michigan. There was also the Calumet system of rivers. A natural ridge separates the Great Lakes Basin from the Mississippi Basin, so that all of the rainfall that falls to the west of this ridge would flow toward the Illinois River and eventually down to the Mississippi. The rainfall on the east side of the ridge would flow into the Chicago River system and then on down into Lake Michigan.

The early sewer system was a combined sewer system, all feeding into the Chicago River. It would collect rainwater and sewage. At the time of a rain the water would automatically go into Lake Michigan. Now in the minds of the people in those days, they looked at this great big body of water and figured nothing could ever happen to Lake Michigan, and they could continue to put polluted river water into it. But as time passed there were greater and greater incidences of water born diseases.

To obtain drinking water, the engineers built water intake structures further and further out into the Lake. But as the population increased, the heavier storms would flush these sewers out, and as you can see the polluted water would get into the drinking water via the river and lake. That led to a very, very large typhoid rate and other water born diseases. In 1900 a dramatic drop in the typhoid rate occurred with the reversal of the Chicago River.

On August 3, 1885, there was a very large rainstorm which caused many, many thousands of illnesses and hundreds of deaths in the Chicago area. In 1889, the Metropolitan Sanitary District was created by the state legislature. It was charged with the responsibility of collecting, treating and disposing of the sewage waste from the City of Chicago and the preservation of Lake Michigan. To accomplish this, a channel was dug from the beginnings of the Chicago River through this ridge. It was the main channel of the Chicago Sanitary and Ship Canal, and it was dug down to Lockport, Illinois--a distance of about 30 miles. This work took place from about 1892 to 1900. As I said, the canal was 30 miles in length, it's about 24 feet in depth, and it was about 160 feet across.

Later, the North Shore Channel was dug from the Wilmette Harbor to the North Branch of the Chicago River. Water flowed from the Lake so all of the wastes which flowed into the river system and the canal system were "flushed" down to Lockport and then down the Illinois Waterway. The amount of water that was taken out of the lake by these canals averaged as high as 10,000 cubic feet per second. During some periods even larger amounts of water were taken out of Lake Michigan and were flushed on down. The pollutants that had been going into Lake Michigan during very heavy rain storms were effectively stopped because locks were built at the mouth of the Chicago River, at Wilmette, and on the Calumet River to keep the polluted water from going into Lake Michigan.

As I said in the early years, from 1900 until the mid '20s and '30s, there was a higher amount of diversion water and dilution water taken out of Lake Michigan. In response to the action of the other Great Lake States, the Supreme Court entered a decree in the late '20s that the total amount of diversion water that could come out of Lake Michigan would be limited to 3,200 cubic feet per second which is the amount that is presently the standard. That is the total amount of water that could be taken out for domestic pumpage, for dilution purposes and for every other purpose. It became necessary then, at the beginning of the '20s and into the '30s and the '40s, for the District to build advanced secondary sewage treatment plants, so that the sewage from these combined sewer systems which were coming into the plants could be treated. The clean effluent from the plants could then be returned to the canal, because we did not have the luxury of diluting it with millions and millions of gallons of Lake Michigan water. This sewage treatment plant, the world's largest, was built in the '30s and '40s and expanded, of course, through the years and was upgraded. It still produces an effluent that is better than 98 percent solids free and this effluent is returned to the canal. It flows eventually to the Illinois River and into the Mississippi. This is the system that has continued in operation from the

mid '30s and into the '80s. We thereby accomplished the first objective of eliminating the flow of polluted material directly into the lake.

However, because of the fact that the City of Chicago and many of the surrounding suburbs, the older suburbs, have combined sewer systems, whenever it would rain the combined sewer system would overflow into the rivers and canals. If it was a heavy rainstorm it became necessary to open the controls and sometimes the locks and allow a backflow from the waterways into Lake Michigan. In the last 15 years there have been about 23 instances when rainstorms were heavy enough that it became necessary to backflow.

In the last 15 years this pollution has occurred 23 times, but even one time is too much. That was the reason that we entered into what is called the Tunnel and Reservoir Project. The purpose of the system is to eliminate those backflows.

The Tunnel and Reservoir Plan became possible after the passage of the 1972 Clean Water Act, which mandated, as a national goal, the elimination of combined sewer overflows. This project, Phase I of the Tunnel and Reservoir Project, (I'm only going to talk about Phase I) was eligible for funding through the USEPA as a pollution control project.

I'm sure most of you understood how combined sewers work. They take the waste from the homes, offices, industries and what not, down to the sewage treatment plant during dry weather. During the time of rain, rainfall enters the same system and it is necesary to overflow excess combined sewage into the nearest canal or waterway at an overflow point.

On our entire system, there are about 640 of these overflow points on the river and canal system. The idea of the deep tunnel--it became possible because of the solid strata of rock that we live on here--was to dig a tunnel 200 to 300 feet below the surface of the ground through the rock by utilizing a tunnel boring machine. The tunnel itself varies in diameter from 20 to 33 feet.

At overflow points there are vertical dropshafts to that instead of overflowing into the canal the sewer overflows directly into this dropshaft and down into the conveyance tunnel. It is stored and when the rain is over it flows to pumping stations. Pumping is usually done during night time hours to take advantage of cheaper electric rates.

When it is pumped up it goes to the sewage treatment plants where it is purified and the cleaned effluent then flows back into the waterway. The cycle then repeats itself with the next rainstorm. Phase II of the project has flood control benefits and is not eligible for USEPA funding. That is an entirely separate consideration that we won't get into today.

The Main Stream System of Phase I, which has just recently been completed, and will be fully operational by the first of November, extends 11 miles from the mouth of the Wilmette Harbor running underneath the canal, underneath the Chicago River and all the way out here to Hodgkins, Illinois, a distance of

31 miles. After the rain is over a pumping station pumps the combined sewage back to the sewage treatment plant where it is treated.

A small section of 6 miles around O'Hare Field in the City of DesPlaines is separately operable. It has been operating now for the last two or three years, and it has been a highly successful operation.

The Calumet section is partially completed and the rest of the TARP tunnels are awaiting funding. I stated that during the past 15 years there have been approximately 23 instances where we had overflows into the lake. Mostly the backflows have been up at the mouth of the Wilmette Harbor. The canal rises so high that it is ready to go over its banks and, at times, we had to open the locks and allow the water to go back out into the lake. Another point where we have backflows is at the mouth of the Chicago River and also at the Calumet section.

Had the tunnel been in operation during the past 15 years, all but one of those 23 instances would have been able to have been contained within that tunnel, because it in itself has a capacity of just under a billion gallons of water. Now with this particular project in operation, we know that the problem of backflows into Lake Michigan will be virtually eliminated, and so we have accomplished that goal.

The first goal was eliminating the direct polluted discharges into Lake Michigan, i.e., the pollutants from the Chicago River, through the reversals. The second goal was achieved through the building of the deep tunnel thereby avoiding the instances of those backflows to Lake Michigan.

The third item that I mentioned earlier, was the Industrial Waste Ordinance that we have adopted. We are very proud of this ordinance. We know it goes beyond the requirements of both the State and the USEPA. It is one of the most comprehensive industrial waste ordinances and it has what we call Appendix A to that ordinance. Appendix A states there will be NO discharge into the waters of Lake Michigan. The entire Industrial Waste Ordinance dictates the parameters of pollutants that may be put into the sewer system and into the river and the canal systems, but a separate appendix which covers Lake Michigan says there will be no discharge.

This is the impact of that. The City of Chicago, like the many other cities that take water of the lake for drinking purposes, has large filtration plants on the shores of the lake. When it is necessary for them to backwash the filters, the effluent that comes out of that backwash, under the provisions of this ordinance, is not allowed to go back into the lake from whence it came.

It must go into the sewer and be transported away. We think that is a very stringent ordinance. We think that the purpose is a very good one, and it is dictated by the desire to keep the lake waters as clean as they are now and to continue to improve them.

We at the Sanitary District have expended substantial billions of dollars in order to upgrade our facilities to the point where we can provide protecton for the lake and our drinking water. We have received substantial aid from the USEPA for the Deep Tunnel Project. Without that, it would have been impossible to construct the tunnels that have been built. But of the $1.4 billion that has been spent on the project thus far, 25 percent of that came from our local taxpayers. We feel that the investment is worthwhile and that all steps that can be taken to continue to protect and improve the quality of the waters of Lake Michigan, as well as the other Great Lakes, are certainly worth the expense.

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HUMAN HEALTH ASPECTS OF POLLUTION IN THE GREAT LAKES

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The Great Lakes contain about 20 percent of the world's fresh surface water and provide drinking water to an estimated 23.5 million people. Approximately 15 percent of the U.S. population and 50 percent of the Canadian population live in the basin and thus have the potential of being influenced by the presence of toxic chemicals or microorganisms present in the Lakes. This presentation will deal specifically with the chemical pollution encountered in the Great Lakes and the potential impact of that pollution on human health.

The three health related questions most commonly asked about Great Lakes water quality are: Can one swim in the water? Can one eat the fish? Can one drink the water? These three questions cannot be answered simply or universally for all areas within the Great Lakes. It is commonly known that not all beaches are safe for swimming (Toronto beaches are a good example). Likewise, fish advisories are in effect in many areas of the Lakes, generally because of mercury and PCB contamination. Although there are not such advisories on drinking water drawn from the Great Lakes, there has been a significant concern over the myriad of chemicals detected in drinking water, albeit at rather low levels. In order to help you appreciate the nature and extent of chemical pollution in the Great Lakes I would like to reference the 1985 report on Great Lakes Water Quality that was presented this past June by the Great Lakes Water Quality Board at the Biennial Meeting of the International Joint Commission held in Kingston.

The report proclaims that persistent toxic substances is the principal issue confronting the Great Lakes. There are now over 60,000 chemicals produced or used in manufacturing in the United States and Canada, and many have been detected in the various components of the Great Lakes ecosystem. This emphasis on persistent toxics represents a gradual but significant shift in the pattern of pollution in the Great Lakes over the past decade. In the early 1970's phosphorus, the conventional pollutants (B.O.D., suspended solids) and to some extent some heavy metals such as mercury, were the focus of concern. The Board report outlined some 42 areas of concern and indicated the types of problems. Six of these areas are in Lake Superior, eleven in Lake Michigan, four in Lake Huron, eight in Lake Erie, eight in Lake Ontario and the remaining five in connecting channels. In 38 of 42 areas there are concentrations of one or more toxic substances (persistent organics and/or heavy metals) that exceed guidelines or objectives for the protection of aquatic life, human health or the open water disposal of dredged materials. Advisories are in effect in 31 of 42 areas warning the people not to eat the fish there. Mercury and PCBs are the major source of contamination in fish.

Waukegan Harbor near Chicago is one of those areas of concern. At a recent Water Quality Board Meeting held here in the Chicago area, a presentation was made by the USEPA on the situation. Specifically, the drainage ditches and harbor areas are heavily contaminated with PCBs, and in some instances the sediments contain as much as 500,000 ppm. As a result, there are fish consumption advisories issued. A remedial action plan has been developed by EPA for areas of heaviest contamination, but implementation of that plan seems to have been stalled at least for the time being. The estimated cost of cleanup was $21 million.

In response to the toxics issue, the Water Quality Board on the IJC has adopted a dual approach to protect the Great Lakes from the impact of toxic substances.

The primary track is an action-oriented approach that will address a short list of known critical pollutants. These chemicals are all present in the ecosystem. They are all toxic, some of them highly toxic; they are all persistent and/or can bioaccumulate to levels which can threaten human health and/or the aquatic ecosystem. The concern regarding these substances is not new; that is, their presence and detrimental effects have been recognized for years. The Board considered it reasonable to use these selected substances to characterize sources and pathways, and to guide surveillance, modeling and remedial studies. Several of these chemicals are members of larger families of chemicals (benzo-a-pyrene is a member of the polynuclear aromatics).

Therefore, action taken to control one substance may well control other substances as well. The Board will revise the critical list of pollutants when either the information dictates that the presence of a chemical has declined to a point that it is considered controlled, or information has been developed which suggests the need to add a substance.

The primary track utilizes existing information, and its immediate goal is to identify needed remedial programs. The various committees of the Board have been asked to immediately identify and quantitate to the extent possible sources of critical pollutants. In addition, the Board will review and report on the Parties use of their authorities to eliminate the input of these critical pollutants from identified sources.

It is hoped that all necessary remedial programs can be implemented by the jurisdictions within the next 3 to 5 years, but it is also recognized that for some sources there may be no "quick-fix" because some sources have not yet been fully characterized or quantified.

The secondary, or comprehensive, track will attempt to organize and manage the large inventory of chemicals identified in the Basin. Over 1,000 such chemicals have been identified to date and not all of them warrant the same attention or concern. The task, then, is to organize the inventory in order to identify chemicals of concern, plus chemicals for which information needs to be developed.

The procedure being followed encompasses a number of diverse activities including verification; grouping by chemical class, source and environmental

fate; and hazard assessment. If, at the outcome of the hazard process, a substance is deemed to pose a threat or potential threat to human health or the aquatic ecosystem, the substance would become a candidate for regulatory control and be subjected to primary track procedures described previously.

There are several emerging issues that have the potential to impact on water quality in general, and human health in particular. The first such issue is the one of atmospheric input of pollutants. We are all aware of the importance of atmospheric deposition in terms of the acid rain phenomenon, but it is now recognized that this route is also important in the transport of other chemicals as well. A good example of this is toxaphene, thought to primarily originate from Central America, and deposited in Lake Superior through air transport mechanisms. It is rather obvious, therefore, that we need more information on sources and pathways for this mechanism.

Another issue requiring further research and information deals with contaminated sediments. Sediments can act as a significant trap as well as a source for both nutrients and toxics. Sediments contaminated with toxics can impact on bottom dwelling organisms and contribute to aquatic food-chain bioaccumulation.

The last issue is groundwater contamination and the potential for such groundwater to contaminate the Great Lakes. Since it is estimated that as much as 50 percent of the inflow to the Great Lakes could arise from groundwater, this source may represent a rather significant source of contamination.

Let me conclude this presentation by coming back where I started: the three questions that are most commonly asked about Great Lakes Water Quality. The question about drinking water is relatively straightforward. Yes, we can drink the water. There are still many questions to be answered about the characteristics and quantity of chemicals in the drinking water, but we can say with some assurance that drinking water supplies drawn from the Great Lakes do not pose any immediate threat to human health. The question on the acceptability of fish has to be a yes and no, recognizing that there are fish advisories in many parts of the Lakes. Similarly, with bathing beaches there are some locations where it is not safe, but these are relatively few in number.

In terms of the future, I hope that there will be continued improvement in the quality of the waters of the Great Lakes. This, however, is not a time for complacency or weakened efforts to clean up and protect the Lakes. Everybody, including users, scientists, politicians and above all, the public, needs to recognize the value of the Great Lakes as a resource and to commit themselves with vigor to the principles of restoration, prevention and protection.

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EFFECTS OF TOXICS ON AQUATIC LIFE

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Introduction

I am pleased to have the opportunity to talk to you about the effects of toxics on aquatic life. This indeed is a complex subject, and an issue which could be discussed at length over a period of many days. Since my presentation is limited to minutes, and not to days, I will provide you with a broad overview of this very important subject.

When we think of Great Lakes, the thoughts which come to mind are of blue waters and sandy shorelines. We use these lakes as a source of drinking water and for various other activities such as fishing, boating, and swimming. However, the Great Lakes also are a useful resource to the many industries located along the shorelines--steel mills, automobile plants, and various chemical industries. Some of these industries, as part of their processes, release toxic chemicals into the environment. Such toxics enter the lakes through effluent discharges and atmospheric release. Significant amounts of toxic substances also enter the Great Lakes from agricultural and urban areas located in the drainage basin. Not all chemicals entering the lakes originate from the drainage basin. Some (such as toxaphene, DDT, and lead) have sources in agricultural, urban, and industrial areas hundreds of miles away and are carried via atmospheric pathways to the Great Lakes.

Many of these chemicals are deemed toxic substances because: (1) they are harmful to aquatic life at very low concentrations, and (2) they often occur in sufficiently high concentrations to warrant environmental concern.

Toxic substances can be divided into two basic classes of compounds--inorganic compounds such as copper, mercury, lead, zinc, and cadmium, and organic compounds such as polychlorinated biphenyls (PCBs), DDT, dieldrin, and toxaphene.

These compounds differ in their physical-chemical properties. Some organics such as PCBs and DDT are highly soluble in fats and tend to biomagnify up the food web. Others are less fat-soluble and consequently less readily accumulated by organisms. These various inorganic and organic compounds differ in their toxicity. For example, cadmium is considerably more toxic to aquatic life than zinc. Some toxic substances consist of more than 170 different compounds, some of which are more toxic than others. Thus, given the number and complexity of toxic substances occurring in the Great Lakes environment, it clearly is a difficult problem to quantify the effects of these substances on aquatic communities.

An enormous amount of research has been conducted on the effects of toxic compounds on the biota, but the focus of most of this research has been the examination of laboratory populations with the primary goal the determination of levels at which toxic substances begin to kill various components of the aquatic food web. This is not a very sophisticated approach for examining the effects of toxics on the long-term, normal function of the aquatic ecosystem. There is now an emerging concern that "safe" levels determined in the laboratory may not be sufficiently low to protect the general well-being of aquatic systems over the long-term. As an example, we know that over the short-term, i.e., over a period of weeks to months, smoking has little effect on human mortality. However over the long-term, i.e., years, persistent smoking can result in a significant shortening of longevity. This can be further aggravated by the consumption of a diet high in fats. Similarly, the presence of multiple toxics may serve to intensify the effects of a single toxic substance.

In the remainder of my presentation, I wish to focus on two basic areas of toxic substances and aquatic life. First, I will discuss what we know (and do not know) about the general effects of toxic substances on the various components of aquatic ecosystems. Second, I will discuss how living organisms contribute to the persistence and recycling of toxic substances.

Food Web Structure

Although the structural features of aquatic ecosystems are subject to tremendous variation, all share common features. At the base of the food web are the small plant cells called phytoplankton which use sunlight, carbon dioxide, water, and minute amounts of nutrients to synthesize organic matter. Phytoplankton are consumed by invertebrates, with zooplankton (small animals) the predominant form in the water column. Zooplankton, in turn, are consumed by small fish, which are then consumed by larger fish.

As these organisms die, they settle to the lake floor where they are consumed and decomposed by various benthic (bottom-dwelling) species. Nutrients released during decomposition are returned to the water column under various physical events, and are again made available to the phytoplankton. Thus the cycle of life continues.

Terrestrial organisms that consume aquatic life also may be considered part of the aquatic food web. Such organisms include birds such as herring gull, and mammals such as mink.

Toxic substances have the potential to affect all components of the ecosystem and as a consequence, alter the recycling of energy through the food web. The structure of the food web may be altered if sensitive species are adversely affected.

Furthermore, many toxic compounds are absorbed by organisms from their diet, and tend to biomagnify up the food web, reaching high concentrations in large-bodied organisms such as fish and birds. The sediments can serve as an important sink for toxic substances.

What do we know about the effect of toxic substances on the various components of the aquatic ecosystem?

Phytoplankton

Toxic substances clearly can have adverse effects on phytoplankton cells. The two most commonly studied responses are impaired photosynthesis and impaired growth. We know that some species are more sensitive than others and that, in the laboratory, we can change the species composition of a phytoplankton assemblage by exposing populations to compounds such as DDT and PCBs. However, we do not know what effects toxic substances have had on phytoplankton community structure in the Great Lakes. This is because much of our research on phytoplankton communities has focused on nutrient issues, and up to now, we have not attempted to separate out the effects of toxics versus nutrients in producing change. We know very little about phytoplankton community structure in regions of the lakes where concentrations of toxic substances are relatively high, e.g., in various harbors and industrial areas.

We do know that phytoplankton can store toxic substances within their cellular structure. Lead, for example, tends to be stored within polyphosphate bodies which serve as nutrient reserves for algae in times of low phosphorus (an essential nutrient) availability. This has two important implications. First, lead may not become harmful to the cell until it is exposed to a low-nutrient environment. At this time, lead is mobilized along with stored phosphorus. Second, this storage may play an important role in the transport of toxic substances from an area of high contaminant concentration to more pristine waters. For example, the diatom Fragilaria is very abundant in Saginaw Bay. While in this region, diatoms incorporate not only nutrients, but also toxic substances from bay waters. As phytoplankton cells are carried out of Saginaw Bay into Lake Huron by prevailing currents, they transport accumulated toxic substances into the open lake. There these phytoplankton cells may be consumed by zooplankton and eventually by the fish.

Zooplankton

Zooplankton, as stated earlier, are small-bodied organisms and consumers of phytoplankton. Like phytoplankton, they have relatively short generation times and are ideal for laboratory studies investigating the effects of toxics on growth rates, birth rates, and longevity. Zooplankton are widely used in bioassay tests evaluating the toxicity of individual compounds and mixed effluents. It has been found that Daphnia (a water flea) may have severely impaired reproductive rates when exposed to various effluents collected along the course of a river receiving industrial discharges.

Like phytoplankton, zooplankton are sensitive to very low concentrations of contaminants such as cadmium. Furthermore, there is strong evidence that sensitivity varies with the species. Thus, low concentrations of toxic substances potentially can alter zooplankton community structure. Since the early life-history stages of most fish are highly dependent on a zooplanktonic diet, alterations in zooplankton community structure potentially could have significant effects on fish populations.

As with phytoplankton, we have a very poor understanding of the specific effects of toxic substances on Great Lakes zooplankton communities. Much of the research on zooplankton communities has focused on their responses to changes in phytoplankton abundance and composition and to a lesser extent, to changes in fish planktiovores. Relatively little work has been done on zooplankton community structure in areas where toxic substance concentrations are highest. Thus, we do not know how toxics have affected zooplankton communities over the decades.

One interesting aspect of zooplankton is their potential role in the transport of toxic substances to the lake floor. In the marine environment, it has been shown that zooplankton egestion products (or fecal pellets) are a major transport route carrying toxic substances to the ocean floor. A similar role probably occurs in the Great Lakes environment. Zooplankton fecal pellets are densely packed with organic matter, especially from the consumption of phytoplankton. Such pellets may settle at rates of 10 to more than 300 feet per day.

Benthos

The benthic community is that group of organisms living in and on the lake floor. It consists of a wide group of animals--various worms, clams, scuds, to name a few. These animals are larger than zooplankton and generally longer-lived with life expectancies in the order of weeks to months. Because benthos are sedentary, they are important integrators of events occurring within the water column and the sediments. Concentrations of toxic substances often are especially high in the sediments as toxics accumulate from the overlying water column year after year.

Toxic substances, as metabolic poisons, affect the same functions in the benthos as in zooplankton, e.g., growth, reproduction, and feeding. Effects of such impaired functions may become manifest as changes in the abundance and composition of benthic communities in areas where toxic concentrations are high. For example, abundances of the amphipod Pontoporeia often decrease markedly near sources of pollution; amphipods are very important organisms in the lake ecosystem, serving as a major food item for many species of fish. In very polluted areas, only the most hardy benthic species may survive. However, many of these species are less desirable (than amphipods) as a fish food. In severely polluted areas, even the hardiest benthic species are unable to persist.

In the laboratory, researchers have exposed benthic animals to sediments from various harbors and confirmed that some sediments are quite toxic. For example, amphipod mortalities were high when these organisms were exposed to sediments from Indiana Harbor, the Rouge River, and from harbors in Buffalo and Cleveland. Conversely, survival was high when amphipods were exposed to sediments from "clean" areas. However, the specific factors causing these mortalities was not resolved. Harbor sediments, like lake waters, generally contain a mixture of toxic substances, i.e., various metals and organic compounds. Thus, cause and effect relationships are difficult to establish. Some work is being done in this area through sophisticated multivariate statistical procedures, but we still have a long way to go.

There also is some evidence that exposure to toxic substances may cause structural malformations in benthic organisms. Researchers have observed various deformities in the teeth of midge larvae. Furthermore, there is a reasonable correlation between the occurrence of deformities in midge larvae and contaminated sediments. Again, cause and effects relationships have not been established. However, the incidence of deformities appears to have increased with time. This has been determined by examining the fossil record preserved in lake sediments. In the early 1880s, the incidence of deformities was low in midge larvae inhabiting the Bay of Quinte, averaging less than 9 deformed animals in 10,000. This increased to about 106 in 1951 and 199 in 1972, a more than twenty-fold increase. The increased incidence of deformities coincided with the growth of industrial activity in the region.

The benthic community plays two potentially important roles in the recycling of toxic substances through the lake ecosystem. First, many animals are burrowers, constanting reworking the sediments--they are the worms of the lake floor. As contaminants become buried in lake sediments, benthic organisms remix toxics to the surface. Toxics then may re-enter the water column through various physical events (vertical mixing, lateral current flow, absorption to flocculent particles, etc.). A second important role occurs when toxic substances within the sediments are taken up by benthic organisms. If these benthic organisms are consumed by fish, significant biological recycling occurs.

Fish

Up to now, I have focused my presentation on the effects of toxic substances on invertebrates. I will now discuss the effects of toxics on vertebrates, focusing on organic compounds. For reasons that are not entirely well understood, there is a strong tendency for certain toxic organics such as PCBs and DDT to biomagnify up the food web. Thus, concentrations increase from phytoplankton to zooplankton to fish. Very high concentrations may occur in bird eggs that tend to be rich in fats. These high concentrations of toxicants can have a multitude of adverse effects on these large-bodied and long-lived vertebrates. Of most interest, because of the possible implication to human health, are impaired reproduction and tumors.

Fish populations in the Great Lakes have changed over the decades because of overfishing, the sea lamprey population explosion, and the invasion of exotics such as the alewife and smelt. Toxic substances may also have adversely affected fish populations. One issue of concern is the general failure of lake trout, and to a lesser extent, salmon, to establish self-maintaining populations. Several factors have been implicated in this reproductive failure, with toxic substances being just one of them. There are various lines of evidence to support this argument.

A recent study compared the survival of lake trout fry of Lake Michigan, Lake Superior, Lake Huron, and hatchery-reared mothers. Lake Michigan fry had considerably higher mortalities than fry from the other three populations of lake trout. In analyzing Lake Michigan lake trout, researchers found more than 400 contaminants, in comparison to only a few from hatchery-reared fish. The presence of multiple contaminants, passed on from the parent fish, may have significant adverse effects in hatching success and fry survival. Furthermore, because of the number of contaminants, it is difficult to identify the most significant toxicants.

Toxic substances may affect tumor formation in fish, especially in bottom-dwelling fish living in close proximity to contaminated sediments. In heavily industrial areas, the incidence of tumors may exceed 10 percent.

Terrestrial Vertebrates

Toxic substances have also adversely affected terrestrial vertebrates. In the 1960s, rank mink had impaired reproduction when fed fish from Lakes Michigan and Erie. Again, this impaired reproduction has potential implications to the well-being of humans consuming contaminated fish. Initially it was thought that the high kit mortality was due to DDT, the known contaminant at the time, but later studies implicated PCBs. The jury is still out on this issue, and other compounds such as dibenzofurans may have been implicated in these high kit mortalities.

Toxic substances also have had pronounced and highly visible effects on various aquatic birds. In the mid-1960s, researchers observed a strong reduction in the reproductive success of herring gulls from Green Bay and Grand Traverse Bay (Lake Michigan) in comparison to the reproductive success of colonies living in more pristine areas. Reduced reproductive success appears to have been due to two factors. First, adults were adversely affected by contaminant body burdens and exhibited poor nesting behavior. Eggs were left unattended for relatively long periods of time, and birds were aggressive. Second, the eggs themselves apparently contained toxic substances that prevented successful chick maturation. The actual toxic substance producing this failure was not determined, although an organic compound was suspected.

Toxic substances within eggs can cause congenital abnormalities in fish-eating birds. Such abnormalities include crossed-bill and deformed feet. Again, while such abnormalities appear to be associated with toxic substances, the casual factors and mechanisms remain unknown.

Summary

Toxic substances can have adverse effects on all biota. At the base of the food web, the greatest concern is the possible alteration in structure and functioning of the aquatic community, e.g., plant productivity, zooplankton composition, and benthic metabolism. At higher levels, we become more concerned about incidences of tumors and birth defects because of possible human implications. There are a great many unknowns regarding the effects of toxics on aquatic life, given the number of contaminants and the complexity of interactions. Our understanding of toxics and aquatic communities is evolving but remains poor, especially in areas where contaminant concentrations are highest, i.e., in the various industrial and harbor regions which are designated Areas of Concern by the International Joint Commission.

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NUTRIENT CYCLING AND ENRICHMENT

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CENTER FOR GREAT LAKES STUDIES
UNIVERSITY OF WISCONSIN

I'd like to thank Governor Thompson and the organizers of this conference for inviting me to make this presentation today. I want to talk about cycles and trends. I am going to talk largely about nutrients, but cannot talk about nutrients, as has been alluded to already, without talking about biological processes and without talking about the physics of the system. If I have time at the end I'll even try to talk about toxic substances.

Earlier this morning Governor Thompson referred to the very high water levels and erosion -- a subject we are going to hear a lot more about today and tomorrow. It is perhaps not widely recognized, but if you look at the record of water levels in Lake Michigan over the last 150 years, it is clear that water levels over that time have tended to be higher rather than lower, and so perhaps the erosion problems we see today are the norm and not the exception. But in the past, particularly in the 1930s and the early 1960s there were very low levels of water when the lake was almost 6 feet lower than it is today. And perhaps when we look at these cycles and then look at all the other problems related to water quality, might it not be coincidental that there appears to be some relationship between water quality and water level. It is when the water levels in Lake Erie were at their lowest in the 1930s and early 1960s that the worst problems of degraded water quality were most apparent. May it be also coincident that as the water depth, or volume, increased the problems diminished.

So as we move into the 1980s and it becomes necessary to look at the research needs for the Great Lakes I think it is important that we step back and critically examine the paradigms which we have used, and, perhaps, even propose some new ones. That is the only way we are going to learn more about the basic processes and mechanisms that control the complex set of interactions occurring in the lakes. It may be that the beneficial effects of nutrient control have been serendipitous and that they could also be explained in terms of the changes such as those in fish populations or water level. What I hope to do in the next few minutes is go through some of the thoughts that I have had over the last two years looking at the Great Lakes coming from a background as a geochemist, interested initially in chemically cycling.

We are really looking now at how effective remedial programs have been, and how we may have overlooked some of the evidence. Have we overreacted, or would the environment have taken care of itself? It may have been, for example, that with the dramatic increase in water level in the late 1960s dilution in Lake Erie may have been the solution to pollution. Of course one could stick one's neck out and predict that, the next time that Lake Erie drops about 6 feet in water level, the problems of degraded water quality will return in spite of all the remedial actions of the last 20 years. This cycle appears to have happened once already between 1930 and 1960. Changes in water level are also important for us since as the water level goes up, so does the rate of erosion of the shoreline. You have heard already in two

talks this morning as to how important suspended sediments are in relation to removing materials from the lake. So it may be that erosion is also our saviour in a way, because if the sediments were not removing the PCBs, DDT and dioxins from the water, the concentrations in fish would be far greater. What can we say about that in terms of sediment loadings and rates? I may get to that towards the end of this talk.

First of all I should like to look at the geochemical cycling of phosphorus and silica. In the 1980 IJC final task force report on phosphorus it was stated that in experiments with natural populations and assemblages phosphorus was shown to be the growth limiting nutrient, and additions of phosphorus will accelerate the growth of diatoms provided supplies of silica are maintained. This implies that if phosphorus is added to the system primary production will increase. If the production of diatoms is increased too far the silica pool in the lake will be depleted and deleterious changes will occur. Over the last decade several papers by my colleagues in Michgan have talked about the evidence of silica depletion in Lake Michigan and the ecological consequences of such a change. While the chemical data indicate considerable change from around 1925 up until the early 1970s. It is interesting to note that the best regression line through the data would predict that the concentration of silica in Lake Michigan should have been zero in 1984. Orwell might have known something! However, a more careful evaluation of the data by a colleague in Minnesota indicated that there is considerable doubt as to the reliability of the data, particularly in the early years prior to 1960 and it now appears that the concentration of silica has not changed significantly in the lake over the last 50 years. However, careful year-round studies at the Center for Great Lakes Studies in Milwaukee of the SiO_2 cycle in Lake Michigan over the last ten years, show an annual depletion of silica, that can be almost total depending on the magnitude of the spring bloom. The idea of a long term depletion of SiO_2 led Schelske and Stoermer to postulate the hypothesis that increased phosphorus loading to the lake causes an increased fixing and sedimentation of SiO_2 led Schelske and Stoermer to postulate the hypothesis that increased phosphorus loading to the lake causes an increased fixing and sedimentation of SiO_2 and as a result of increased diatom production, that would ultimately lead to a condition where there is no silica left in the lake. At that point it was predicted that the system would go from the ecologically desirable mix dominated by diatoms, blue-greens and greens, to a very undesirable mix dominated by greens and blue-greens, a change still observed every summer in Lake Erie. This model is illustrated in Figure 1. If this hypothesis is correct then an increase of a maximum followed by a sharp decrease should occur in the standing crop of diatoms in the lake or in diatom remains in the sediments.

What has actually happened over this period of 50 years or so? Fortunately both the City of Chicago and the City of Milwaukee had the foresight to monitor changes in a variety of physical, chemical and biological parameters on a frequent basis at their water filtration plants. The algal data collected at the Lynnwood filtration plant in Milwaukee between 1936 and 1985 are shown in Figure 2. (A remarkable fact about these data is that the measurements in Milwaukee were made by the same person for 35 years. This is a request for stability in research funding.) If we look at these data carefully and noting that there is a scale change between the top and bottom

plots, it is clear that there is little variation in the concentration of greens and blue-greens over the whole period of observation and that their average annual standing crop is less than 10 percent of the diatoms. The variation in the diatom standing crop is more variable; in 1936, the diatom count started to increase, reaching a maximum in the early 1940s, decreased back to the 1936 value by 1950 and then started climbing again to another maximum in 1966. The standing crop decreased rapidly again to the 1930s value by 1971. The concentrations have remained constant, both in Milwaukee and Chicago, until today and are exactly the same as they were in the early 1930s. If you look at the bottom plot of the blue-greens, which should be the most sensitive to the effects of increased phosphorus loadings you will see little change over the whole time period.

In fact the standing crop of blue green algae decreased until 1952, even though the diatoms increased and then decreased, and have remained constant, even through the 1966 peak of diatom production. In other words the system did not respond as would have been predicted even though the standing crop of diatoms changed dramatically as required by the hypothesis for increasing loadings of phosphorus.

Why? Clearly there has been no depletion of silica, as was concluded by Shapiro, even though there was a three to four-fold increase in the annual average diatom standing crop. It is important to remember that a double peak -- one in 1942 and one in 1966 was observed. If the model for silica depletion had been correct the lake could not have recovered so dramatically in the short time between maxima. As someone else has already mentioned this morning the residence time of water in Lake Michigan is 100 years and it would take a long time for the lake to recover from a total depletion of SiO_2 on a long-term basis. There must be other explanations for the observed changes, even though the concentration of silica has not changed and is being largely recycled every year. We still have the problem of explaining why over a period of years that concentration of standing crop of silica in the lake as fixed by diatoms could go up by a factor of three. As I mentioned earlier, Brooks and his students have studied the annual cycling of silica for more than a decade at the Center for Great Lakes Studies. In January and February, and not many people get out on the lake to make these measurements but Brooks did, he showed that between 1975 and 1985 the concentration of silica in the water was essentially constant, varying between 1.5 and 1.9 milligrams per liter. As we move into spring and the longer days, particularly after the spring equinox, the concentration of diatoms starts to increase and the concentration of SiO_2 in solution to decrease. This process continues through the spring until the formation of thermocline in June when the lake stratifies (Figure 3). The depletion of silica from whole water column, in any year, is variable but is generally greater than 80 percent of the total measured in January. That is, every spring up to 80 to 90 percent of the silica in the whole of the water column of Lake Michigan it transferred from being in solution to a particulate form in the diatoms. For example in 1976, 80 percent of the silica was fixed and there was a certain standing crop of diatoms in the lake. Going back ten years to 1966, a period of time over which time the maximum concentration of silica (as measured in January) in the lake has not changed, the standing crop of diatoms is three times greater than in 1976. How can that be since we must be looking at the same total amount of silica in 1966 and 1976?

In terms of phosphorus, a study of mass balance has shown that the water column contains only 50 percent of that required for the spring bloom and that annual new inputs can only contribute an additional 10 percent. The remainder of the required phosphorus must be recycled from the sediments. This would explain the significant difference in water quality between Lakes Michigan and Erie. In Lake Michigan after the thermocline has set in there is much less primary production because the epilimnion is cut off from the bottom water in contact with sediment, and no additional phosphorus is available. On the other hand, even when Lake Erie is stratified a large proportion of the sediment containing phosphorus remains in contact with the surface water, phosphorus recycling can occur year-round and the algal counts remain high throughout the summer and fall (Figure 4). It is interesting to note that the IJC Phosphorus Task Force concluded in 1980 that there were no conclusive evidence of upward of downward trends in phosphorus concentration in the lakes.

Now, how do we explain these algal standing crop peaks? The Chicago data show the same general features as the Milwaukee data. The timing of the peaks and valleys coincide, but there is a slight difference in that the 1942 peak for Chicago is smaller than the one in Milwaukee. Furthermore, the change in diatom biomass was restricted to two particular species, Tabellari sp. and Stephanodiscus sp., that have not been specifically connected to eutrophication. The silica had to go somewhere. Where did it go? It must be hidden in the system somewhere. Now what other processes can occur in the lake that would affect the diatoms? What other cycles have been going on in the lake? Those of us who were around in 1967 will remember the massive alewife die off in the spring of that year. Could the fish have had an effect? But let me take you on a tour of Lake Michigan through the Chicago and Milwaukee water intakes in relation to what else was happening in the lake (Figure 5). Back in 1912 smelt were imported into the area and accidentally introduced into Lake Michigan. They found it a conducive environment to grow in, the population expanded rapidly and by the early 1930s were a major commercial species. The catch continued to increase until 1942 when suddenly it decreased dramatically. The lake trout population was under severe fishing pressure, and this, when combined with the effect of the lamprey eel that arrived in the lake about 1935, resulted in the almost total elimination of this species by 1949. It was also in 1949 that the first alewives were seen. Between 1949 and 1966 the alewife population burgeoned because of the lack of a major predator and little competition for its niche, and we saw greater and greater despoiling of the beaches every year. The massive die off in the spring of 1967 was the one event that precipitated the major concern about water quality in Lake Michigan. Starting in the mid-1960s the states around the lake introduced salmonid species as a major predator. (Now we are worried that there are not enough alewives to support the salmon fishery.) You will note that as the alewife population crashed so did the algal biomass, and since 1971 this biomass has remained essentially constant. As the smelt or alewife population increased or decreased so did the algal standing crop in almost perfect synchronicity. Is there a connection? Such a connection has been demonstrated in small lakes by Shapiro, and this involves the intermediate part of the food chain -- the zooplankton. As the fish population increases, the zooplankton species decreased, resulting in an increase in the diatom standing crop. Did this happen in Lake

Michigan? Unfortunately, there have been very few comprehensive studies of zooplankton in Lake Michigan. Fortunately, Wells did make annual population studies in 1954, 1965, and 1968 (Figure 3).

So here you see the relationship between changes in the composition of the various trophic levels. As the fish went up so the diatoms went up -- as the fish went down so the diatoms went down. Furthermore, as the alewife population increased, the large zooplankton, the copepods and daphnia, decreased. The concentration of daphnia and copepods decreased from beng about 70 percent of the zooplankton population to 2 percent, between 1955 and 1965, a change of a factor of 30 while the alewife population was increasing. Immediately after the alewife crash they rebounded. It is unfortunate that there is no more data from that time that we can use. However, I think it is fairly clear that there is a connection between the fish, the zooplankton and the plankton and that we can only understand these systems when we look at the total ecosystem. I never thought I would agree so strongly with Dr. Valentine on this point.

Where does phosphate fit into all of this? As I said earlier there is not enough phosphorus in the water, so where does it come from? Well, back in 1973, quoting some work done in 1958 Goltermann stated that the exchange of phosphorus from sediments is a rapid process. The uptake of phosphorus from the water by algae will be followed by a release of phosphorus from the sediments. I think that the importance of this geochemical processes has been underestimated and that it is dominant in controlling chemical cycling in Lake Michigan. It would also explain the large differences observed in primary production between Lake Michigan and Lake Erie.

Geochemically there is no reason why the concentration of ortho-phosphate, the simplest species which will be utilized by organisms should change in water. This is the result of simple equilibrium relationships that are well known to all inorganic and geochemists. The model we have is that during the spring when the major primary production occurs phosphorus can be cycled from the sediments through the whole water column (Figure 3). In fact, the observations are such that as the spring bloom starts, the concentration of chlorophyll is constant, due to rapid mixing throughout the whole water column. After stratification sets in there is a separation of the system. Phosphorus can continue to be cycled below the thermocline, but its supply in the epilimnion is restricted. This is reflected in the distribution of chlorphyll. Later in the summer the distribution of chlorophyll in the water shows a peak just below the thermocline. That is where the nutrients are. Above the thermocline the primary production is less than one tenth of what it was in the early spring even though the light and temperature regimes are extremely favorable for photosynthesis. As the fall storms come in, the thermocline breaks up and everything -- the phosphorus, the silica -- is recycled and the system is reset to start up again all over next spring. What is the difference in Lake Erie? In this lake, this sequence never really happens because it is too shallow, and most of the water in the lake remains in contact with the sediment year round, so that phosphorus can continue to be released from the sediments and keep primary production going. So in Lake Erie concentration of algae goes up in the spring and remains constant until October and then just falls off as the available light decreases.

So in saying all of this where are we? It is clear that we can still ask questions about our basic premises. As research workers we must ask questions about the correctness of our decisions and actions. I am certain that the decision to build new sewage treatment plants was correct but it poses a very interesting question of whether the ecological reasons were correct. The IJC Task Force even recognized this in 1980 when they said, "The control of euthrophication in the Great Lakes has been of major concern because of deleterious changes in quality and biota. And quality really meant biota. Nevertheless ... other stresses ... may have contributed to these changes." The relative importance of these streams has not been determined.

What I have tried to do today is point out that these stresses did exist and they could have been very important. I was going to talk a little bit about toxic substances and their cycling in Lake Michigan. I will predict if you look at fish 20 years from now you'll find that the concentration of PCB's or other similar chemicals will have decreased by only a factor of 2. That prediction is based on a great deal of work initiated by Don Nelson and other people in my old group at Argonne National Laboratory looking at another pollutant, plutonium, which is also a tracer for particles in the water and sediments. The key to the long term problems of toxic substances all the lakes is the sedimentation processes and sedimentation rate.

Finally I should like to stress that each lake is very different. We cannot extrapolate from the Lake Erie to Lake Michigan. We cannot extrapolate from Lake Michigan to Lake Superior. We cannot extrapolate from the English lakes, Lake Washington, or any other lake, to the Great Lakes. They each have their own chemical cycles that are very different. And this is nothing new. Evelyn Hutchinson, the father of American limnology in his massive tone on limnology said, "It is now quite apparent that would should think not of oligotrophic or eutrophic water types but of lakes and their drainage basins and sediments as forming oligotrophic or eutrophic systems." Lake Erie has always been eutrophic. Lake Michigan will always be oligotrophic.

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edgington

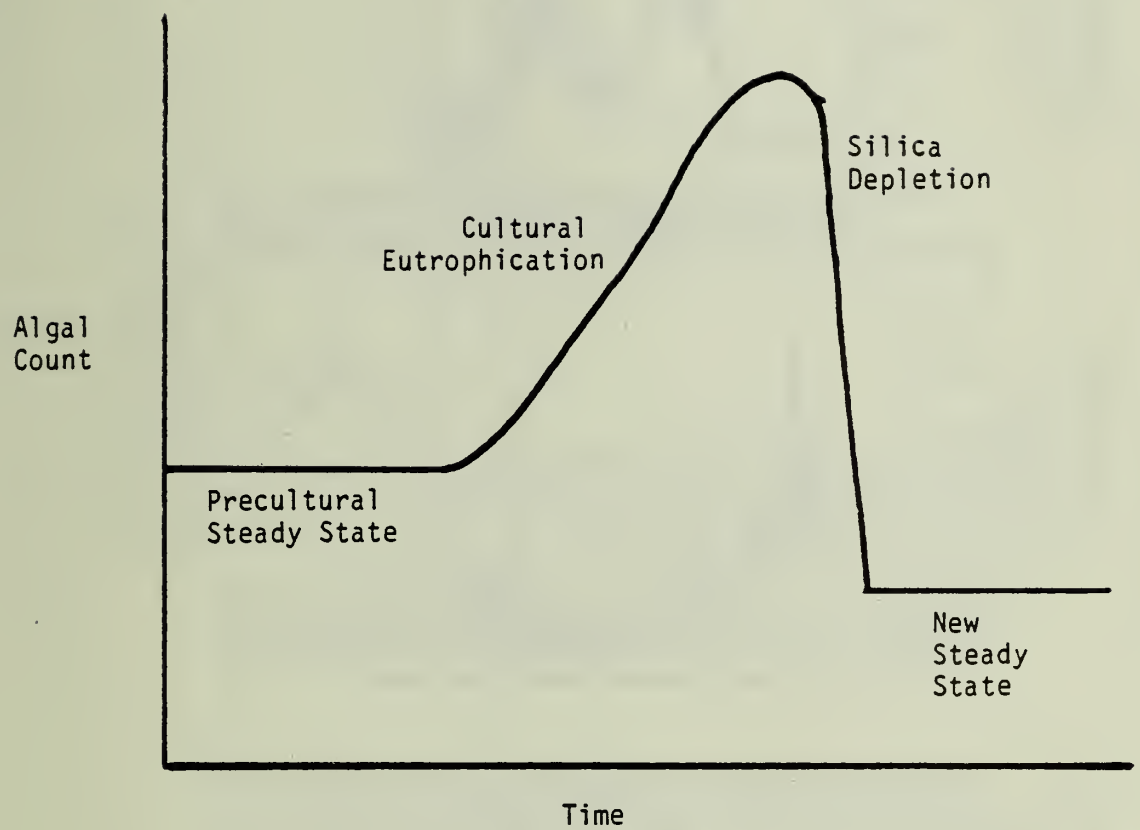

Algal
Count
Cultural
Eutrophication
Silica
Depletion
Precultural
Steady State
New
Steady
State
Time

FIG. 1

FIGURE 2: Total Algal Counts

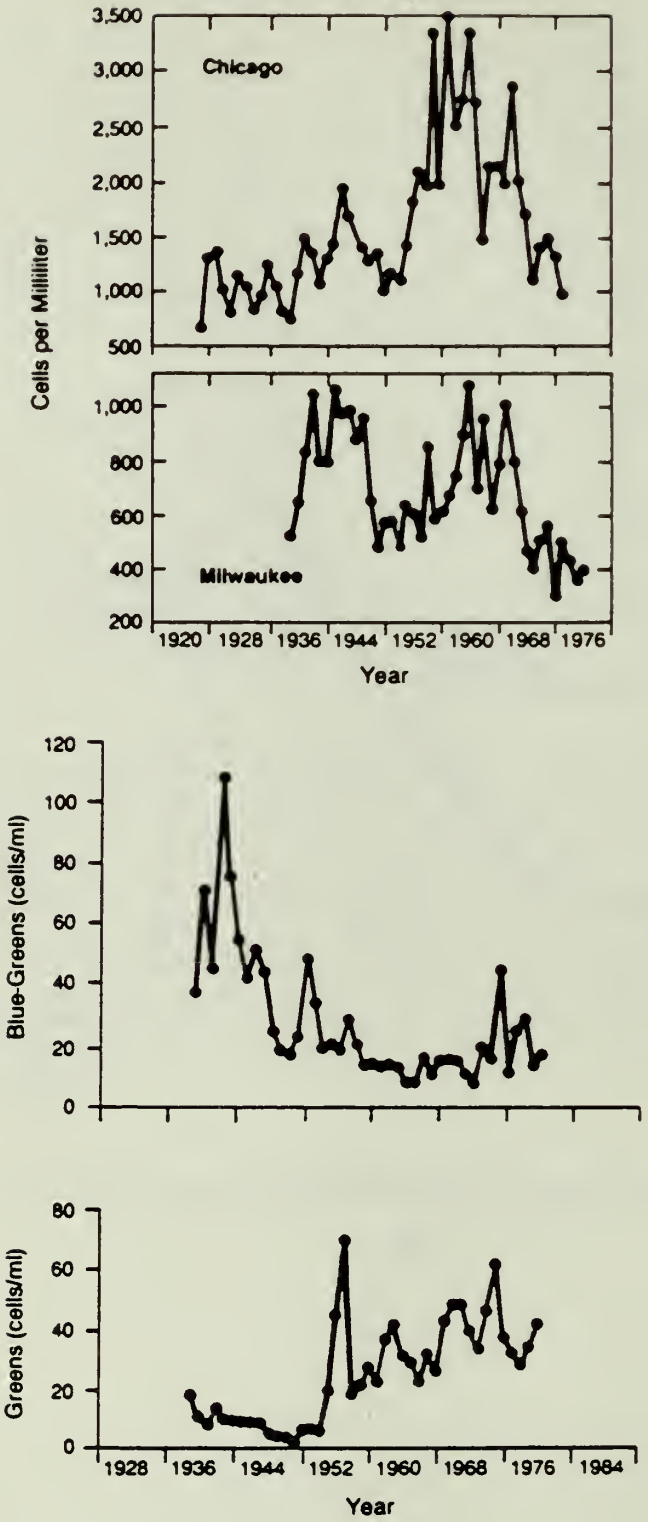


FIG. 2

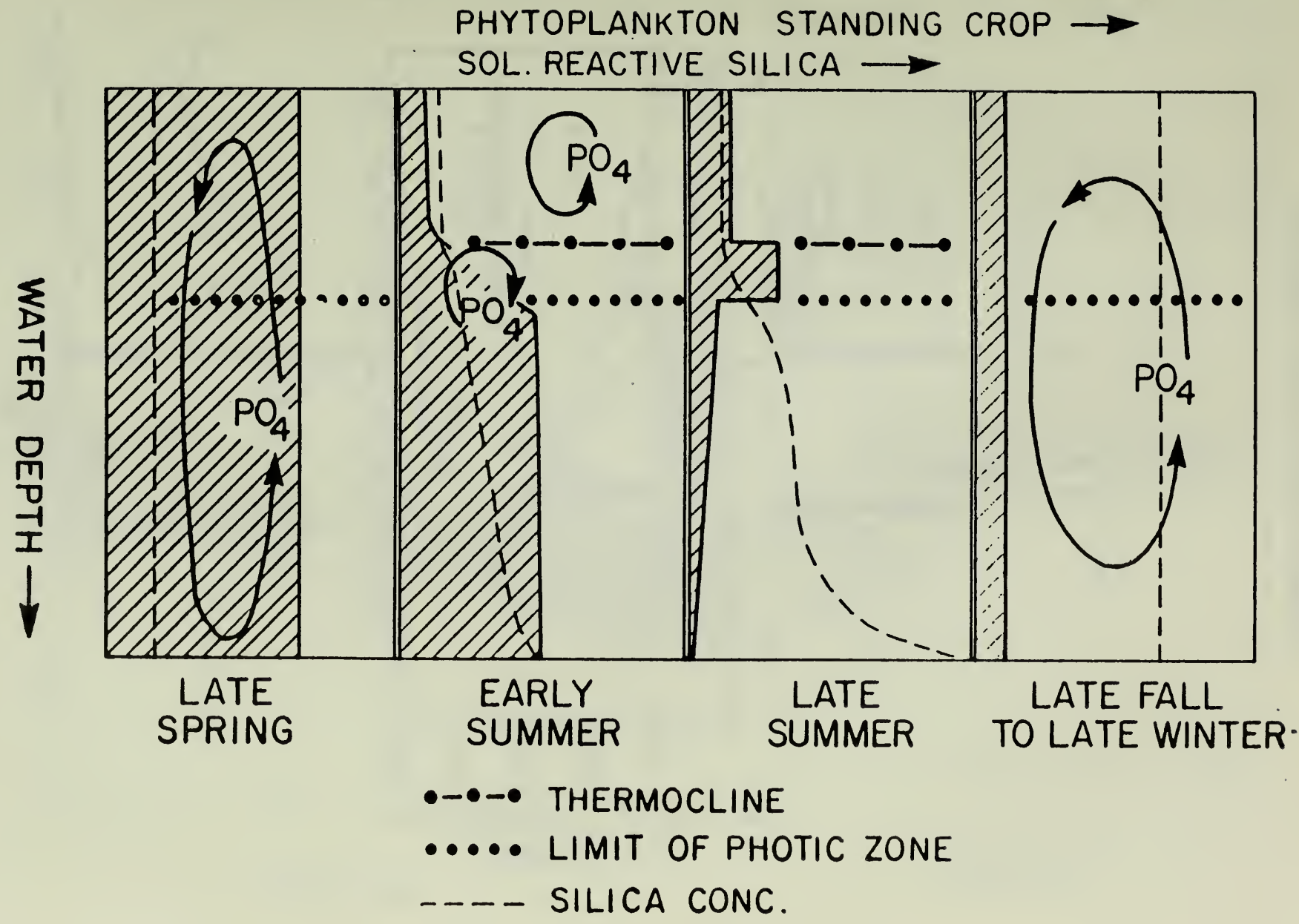

PHYTOPLANKTON STANDING CROP
SOL. REACTIVE SILICA
WATER DEPTH
PO4
PO4
PO4
PO4
LATE SPRING
EARLY SUMMER
LATE SUMMER
LATE FALL TO LATE WINTER
THERMOCLINE
LIMIT OF PHOTIC ZONE
SILICA CONC.

FIG. 3

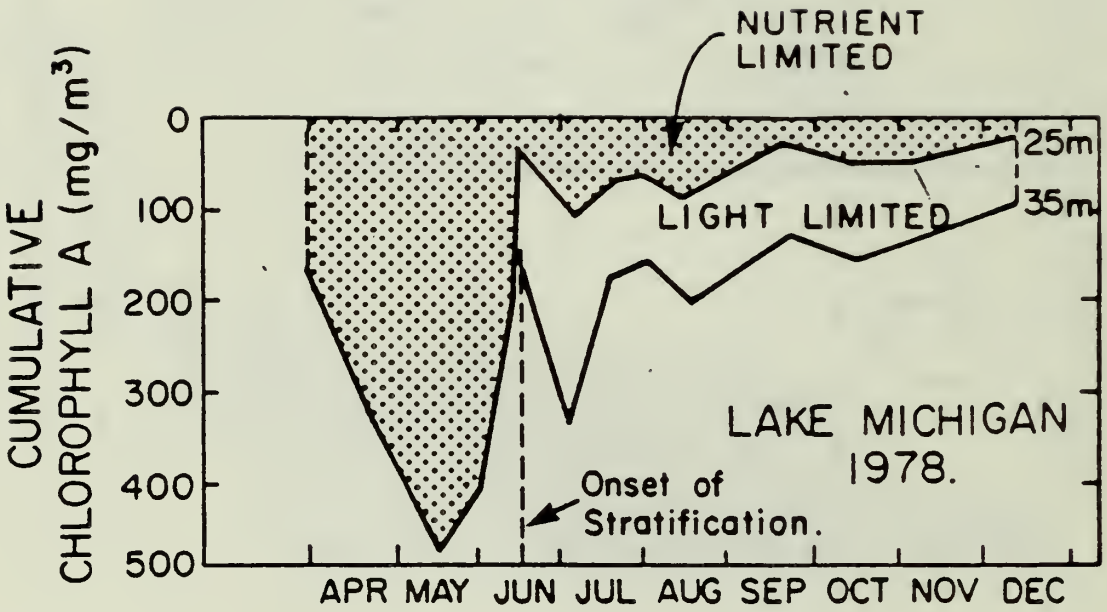
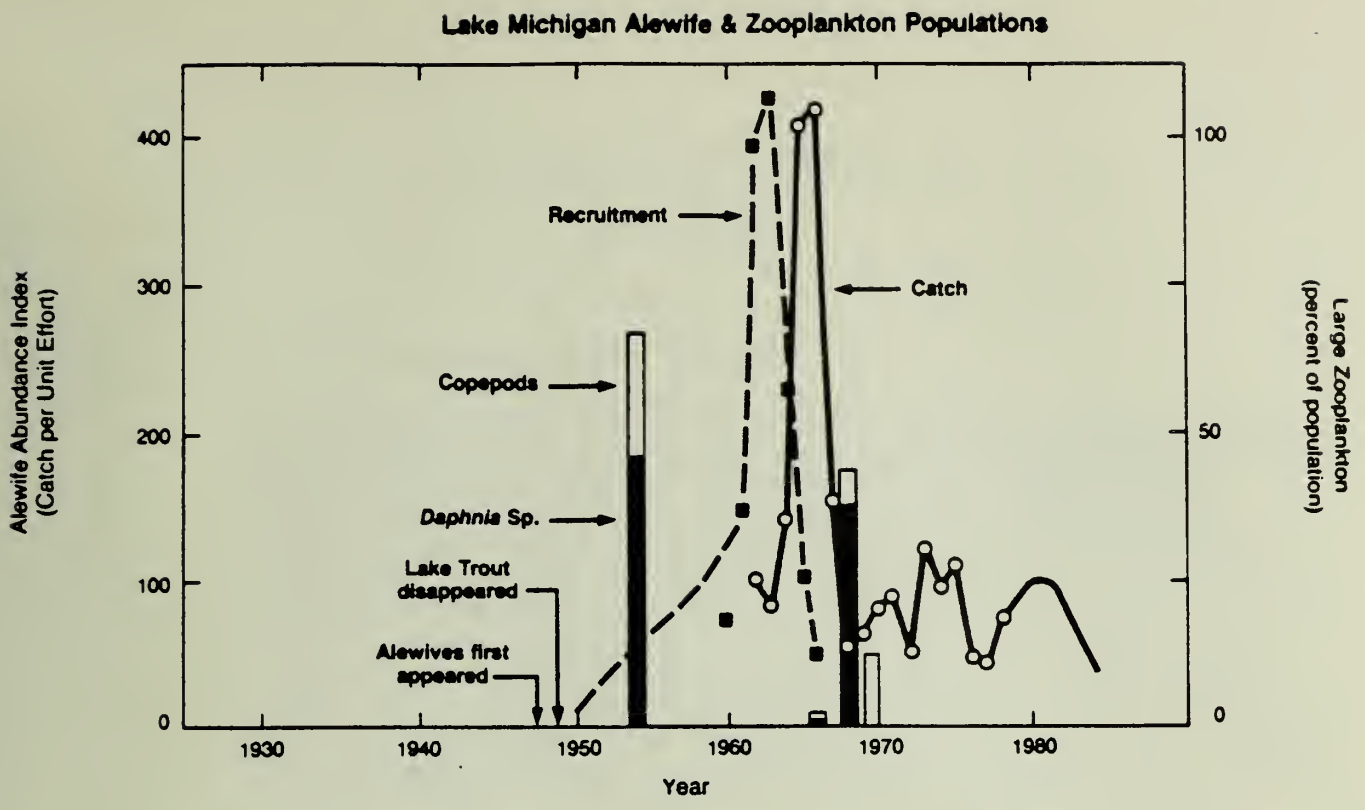

NUTRIENT
LIMITED
LIGHT LIMITED
25m
35m
LAKE MICHIGAN
1978.
Onset of
Stratification.
CUMULATIVE
CHLOROPHYLL A (mg/m³)
0
100
200
300
400
500
APR MAY JUN JUL AUG SEP OCT NOV DEC

FIG. 4


Lake Michigan Alewife & Zooplankton Populations
Alewife Abundance Index (Catch per Unit Effort)
Large Zooplankton (percent of population)
Recruitment
Catch
Copepods
Daphnia Sp.
Lake Trout disappeared
Alewives first appeared
400
300
200
100
0
100
50
0
1930
1940
1950
1960
1970
1980
Year

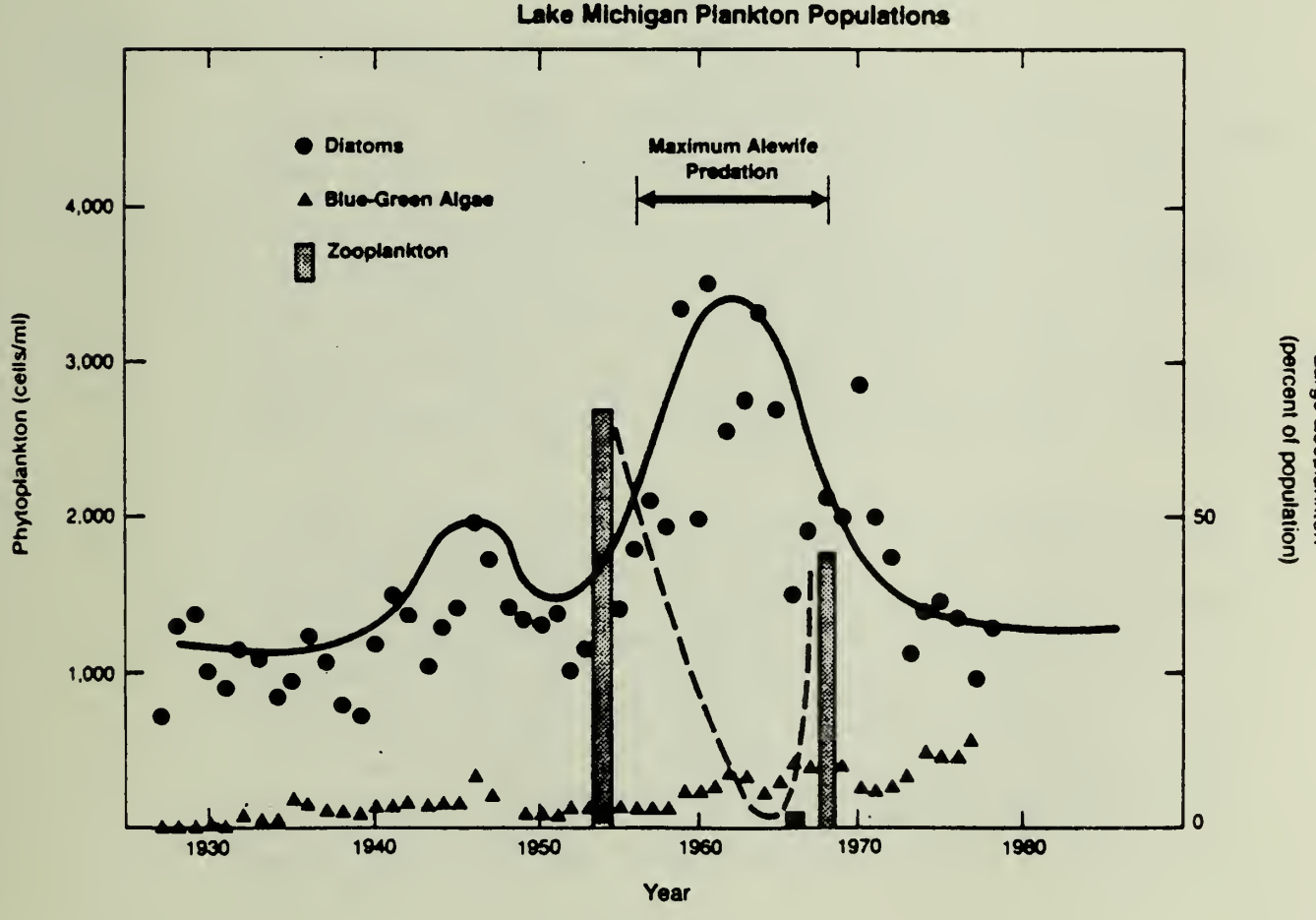

Lake Michigan Plankton Populations
Diatoms
Blue-Green Algae
Zooplankton
Maximum Alewife Predation
Phytoplankton (cells/ml)
Large Zooplankton (percent of population)
4,000
3,000
2,000
1,000
0
50
0
1930
1940
1950
1960
1970
1980
Year

FIG. 5

QUESTIONS AND ANSWERS

WATER QUALITY

Question: BILL PEARCE from State of New York.

One of the problems that we face in the whole big picture is to maintain the public support necessary as we clean the Great Lakes over the next many years. Fish has been our primary concern because people have been assured regularly the drinking water which at this time is not a major problem, while the eating of some of the fish is. Our concern about people who are in the fish business, is when you cry wolf too long, even if the wolf is there, the people ignore it. I'm wondering if IJC and the other agencies are working on some way to address and maintain the public support on a positive rather than a scare crisis negative approach which the public have pretty well had it with it. People won't maintain the support for the cleanup unless we present it in a positive way. I think that's a serious issue that should be addressed.

Answer: DR. VILLENEUVE of the Water Quality Board.

I think that it's well recognized that public perception is a major issue. I think the individual agencies on both sides of the border as well as the commission through its boards are making efforts to better communicate the problems of identification, the problem solution aspects to the public. That is not to say that there are things that can't be improved upon. For instance, one of the things that I would like to implement is an information program in the high schools. Those students are going to be the adult population in ten years time. They are young and enthusiastic. They're keen on the environment and environmental issues. If we could reach that population effectively, I think it would help our progress in solving a lot of the problems.

We should all be reminded also, that the 1978 Water Quality Agreement mandates an information program to be operated through the regional office of the IJC in Windsor. That office has provided materials for college level courses and some of the high school courses and runs conferences from time to time. But as you've seen from several of the talks from this morning, there is also a high degree of uncertainty as to what information is available to put into these public information programs. I think this is where a conference like this can help feed back and guide the IJC and the various organizations all around the Great Lakes Basin as to how to carry on the dialogue with the public in the face of uncertainty and in the face of recognized problems and solutions.

Question: CARLOS FETTERHOLF of the Great Lakes Fisheries Commission. Question for Dave Edgington.

You mentioned a decline in PCBs over some time frame. Where are you measuring PCBs and under what scenario of reduction did you frame that comment?

Answer: DR. DAVID EDGINTON, Center for Great Lakes Studies.

Any substance which is associated strongly with particles will undergo an equilibrium process between water and sedimenting particles. The rate at which this material will disappear, particularly in the upper lakes, will either by decomposition or burial in the undisturbed layers of the sediment. The work that is being done at Argonne and in Milwaukee over the last 10-15 years has shown that the thickness that effectively remains in contact with the water is about 15-20 years worth. Fifteen years of radioactivity data from Argonne show that plutonium is disappearing with a half life at about 10-15 years. I would extrapolate that to any other particle associated pollutant.

Question: That's fine, but what scenario of reduction of input are you using for that when you apply PCBs?

Answer: That would be on the basis of no new inputs.

Question: JIM MC GREGGAN from Ontario, Canada.

Question to Dr. Edgington. You said that the lake levels are tending to be higher than their historical average. Is that possibly because of the drainage of farm lands and swamps and cutting down forests and so on? Do we now have water that historically resided within a cycle outside of the lake waters now residing permanently in the lake waters?

Answer: I'm outside my specialty area so I'm speculating now. My sense is that forest clearance did have a tremendous influence in the early 1800s on water quality in the lakes, as is recorded in the sediments of the lakes. You can see that in sediments of Lake Ontario and Lake Erie, because those two lakes have a very direct connection between the land and the lake. It is not so clear in Lake Michigan because every major waterway into Lake Michigan has a lake between it and the lake and that is where we would look for similar effects. I think the major hydrological problems in the lake are the function of the rainfall. I'm certain Frank Quinn will address this tomorrow. We are fortunate that we're in a period generally of good rainfall rather than poor rainfall. Thus the success of the agriculture.

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LUNCHEON ADDRESS

JAMES L. EMERY

ST LAWRENCE SEAWAY DEVELOPMENT CORPORATION

James L. Emery is the fifth administrator of the United States St. Lawrence Seaway Development Corporation. He was appointed by President Ronald Reagan and was sworn in on February 2, 1984.

The Seaway Development Corporation, a wholly-owned government corporation, receives no tax dollars. It is a self-supporting entity funded by tolls collected from Seaway users.

International in scope, the Seaway Development Corporation, in cooperation with the Seaway Authority of Canada, is responsible for management of a series of locks along the St. Lawrence River which give Great Lakes ports in eight states direct waterborne access to the Atlantic Ocean and world markets.

Beyond this basic mission, Mr. Emery's major goal as administrator is to increase Seaway trade and traffic.

Prior to his appointment to the Seaway Development Corporation, Mr. Emery was minority leader in the New York State Assembly. He served in the Assembly for 18 years.

In 1983, Mr. Emery retired as a Colonel from the United States Air Force Reserve after 30 years of service. His military honors include the Meritorious Service Medal and Legion of Merit.

He holds a degree in business administration from the University of Cincinnati and an honorary doctorate of civil law from Mercy College, Dobbs Ferry, New York.

TELLING THE WORLD'S BEST KEPT SECRET

JAMES L. EMERY
UNITED STATES ADMINISTRATOR
ST. LAWRENCE SEAWAY DEVELOPMENT CORPORATION

I want to thank Governor Jim Thompson for inviting me to speak at this exciting conference on the future of Lake Michigan. It's great that Governor Thompson and the other Great Lakes Governors are working together to promote and develop the Great Lakes on a regional basis.

When President Reagan asked me to take the Seaway job in late 1983, the experts told me I faced two problems. First, they told me the Great Lakes states suffered from a history of fighting each other worse than the Hatfields and the McCoys.

Well, I have to say that I really didn't find that to be true. Being from New York, the Great Lakes immediately united as never before -- in opposition to my nomination! My job was to keep them united. And so far we've been successful.

Second, the experts told me that it wouldn't be a fun job because the Great Lakes was a dying region. And the Seaway was a dying waterway. Well, I've been working very hard to change that image because the fact is the Great Lakes is one of the world's greatest regions, and the Seaway is one of the world's greatest waterways.

Our biggest problem is that we're also one of the world's best kept secrets. I want to tell you about some of the steps we're taking to promote greater world trade for the Seaway. Then I'd like to suggest a few ways the states and the Midwest Congressional Delegation can help.

The Great Lakes region is indeed the agricultural and industrial heartland of North America. Last year the Seaway handled 47.5 million tons of cargo, generating an estimated $3 billion in port-based economic activity. That means sales, income and jobs. More cargo will generate more economic activity for our region.

But business won't just come knocking at our door. We have to go to business. And we indeed to do so aggressively. One step we've taken is to open regional trade and traffic development offices.

Our Toledo, Ohio, office serves the port cities of Toledo, Detroit, Cleveland Erie and Buffalo. Our Deerfield, Illinois, office serves the port cities of Chicago, Burns Harbor, Milwaukee, Green Bay and Duluth. It's headed by Ron Rudolph, who formerly served as Senator Chuck Percy's Administrative Assistant in this area. These offices serve as operation bases for promotional activities such as business outreach, trade fairs and export seminars.

Another major initiative was our highly successful Seaway trade mission to Western Europe in January, 1985. Co-sponsored with our sister agency, the Seaway Authority of Canada, the mission put our port directors in direct contact with importers and exporters in the European cities of London, Paris, Antwerp, Rotterdam and Hamburg.

Incidentally, our mission marked the first time two nations have sponsored a joint trade mission.

We are following up on the trade mission through our Washington-based Embassy Outreach Program to acquaint foreign ambassadors and commercial officers with Seaway trade opportunities, and are now in the early stages of planning Seaway Trade Mission 1986 which will go to the Mediterranean area, touching countries in Southern Europe and North Africa.

The Mediterranean area was targeted for use by an exciting marketing tool we've just acquired from the Journal of Commerce. It's called PIERS, and it's a detailed breakdown of all import and export cargo moving to and from the Great Lakes region. This is the greatest marketing tool we've ever had because our port directors can now pinpoint opportunities for more Seaway cargo, and go after them.

Another exciting marketing initiative is the partnership we're forming with the states. Each Great Lakes governor has appointed a Seaway liaison to work with us on common promotion programs. The liaison group has proposed that each state contribute $20,000 in seed money to a common promotion fund.

The Seaway Corporation will match state money on a dollar-for-dollar basis, making a combined pot of $280,000. This money will facilitate a regional approach in our overall promotion program. We ask that the governors and the state legislative bodies approve the bucks as soon as possible so we can get moving.

The states can also help by providing increased marketing support for Great Lakes ports. East and Gulf Coast ports have been successful in tapping the Great Lakes market because their states have funded sophisticated and comprehensive marketing programs aimed at the Midwest. Baltimore bills itself as a Midwest port.

Our states and cities have made an investment in building and operating Great Lakes ports. Now the ports need marketing support to put that investment to work. In addition to the states, the Great Lakes Congressional Delegation has a vital role in helping the Seaway. The best way I can think of is by supporting President Reagan's trade and tax reform proposals.

Because of the Midwest's heavy agricultural and industrial base, we stand to reap tremendous benefits from the President's trade and tax reform proposals, perhaps more than any other region of the nation. Lower marginal tax rates will spur national economic growth creating increased demand for Midwest products, and a lower dollar coupled with export promotion incentives will

make Midwest farm and food products more competitive in international markets leading to higher exports.

Taken together, these policies should bolster our ongoing, aggressive Seaway trade and traffic development efforts.

Leading advocates of national tax reform, including Congressman Jack Kemp of Buffalo, Senator Bob Kasten of Wisconsin, Congressman Richard Gephardt of Missouri and Congressman Dan Rostenkowski of Chicago, all represent Great Lakes Midwest states. They know tax reform will help us. I'm calling on the entire Great Lakes Midwest Congressional Delegation to unite in a bipartisan effort to enact tax reform legislation this year.

Coincidentally, the leading critic of tax reform, New York Governor Mario Cuomo, was originally scheduled to be the speaker today. Cuomo's real problem with tax reform is that he never met a tax he didn't like.

In addition to tax reform, it's important to support the President's trade proposals. During our trade mission earlier this year, potential European importers complained about the high dollar as the major obstacle to the competitiveness of U.S. exports. The Europeans told us they want to buy American products, but that we have to get the dollar down first. I want to applaud U.S. Treasury Secretary James Baker for his leadership in heading the Administration's trade and tax reform efforts.

In closing, I want to note that the House Ways and Means Committee began drafting tax legislation this week and the President's new trade proposals were announced this week. We may look back on it as the week that turned the Great Lakes economy, U.S. exports and the Seaway traffic around.

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GENERAL SESSION ON WATER QUANTITY

HENRY G. WILLIAMS

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Hank Williams was appointed commissioner of the New York State Department of Environmental Conservation by Governor Mario Cuomo in January, 1983. Prior to his appointment, Commissioner Williams was director of State Planning. He has also served as an administrator with both the State Office of Planning Services and Office of Planning Coordination.

Mr. Williams has been active in numerous environmental groups. He is a fellow of the Soil Conservation Society of America and has received the society's National Commendation Award.

As a member of the faculty at the State University College of Environmental Science and Forestry at Syracuse University, Mr. Williams taught and conducted research in planning, resource management and outdoor recreation.

STANLEY A. CHANGNON, JR.

ILLINOIS STATE WATER SURVEY

Stanley A. Changnon, Jr. is chief emeritus of the Illinois State Water Survey He served six years as chief and 12 years as head of the atmospheric sciences section. He is also a professor of geography at the University of Illinois. Mr. Changnon has authored more than 240 scientific papers and reports concerning meteorology, climatology and water resources.

He was chosen by the American Geophysical Union as the 1974 recipient of the Robert E. Horton Award. A paper he wrote was recognized in 1966 by the Building Research Institute as a Scientific Contribution to the Science of Building, and a 1976 paper was awarded best of the year by the American Water Resources Association. The American Meteorological Society honored him with the Cleveland Abbe Award in 1981 for outstanding contributions to applied atmospheric research.

Mr. Changnon is a member of the Weather Modification Association (past president), American Association of Climatologists (past president), and a fellow of the American Meteorological Society and the American Association for the Advancement of Science. He served four years as chief editor of the *Journal of Applied Meteorology*. In addition, Mr. Changnon has served on several advisory committees to the National Academy of Sciences and to federal and state agencies.

FRANK H. QUINN

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Frank H. Quinn is the head of the Lake Hydrology Group, Great Lakes Environmental Research Laboratory of the National Oceanic and Atmospheric Administration in Ann Arbor, Michigan. He is responsible for NOAA's hydrologic, hydraulic and ice research on the Great Lakes and their connecting channels.

Dr. Quinn's speciality is the hydraulics and hydrology of large lake systems. He has worked on the Great Lakes since 1962 and has more than 30 publications to his credit. He is past president of the International Association for Great Lakes Research and is a member of several boards and task forces of the International Joint Commission and other Great Lakes committees.

Dr. Quinn received a doctorate in civil engineering from the University of Michigan.

CHARLES COLLINSON

ILLINOIS STATE GEOLOGICAL SURVEY

Charles Collinson has been with the Illinois State Geological Survey since 1952 and has been coordinator for geological research in Lake Michigan since 1974. He is author of some 20 articles on Lake Michigan and has developed numerous maps. Among them is an atlas of the Illinois Lake Michigan shore. A graduate of Augustana College and the University of Iowa, he has taught marine science at the University of Illinois at Champaign-Urbana and at Stanford University.

A Guggenheim Fellow, Dr. Collinson has been an editor or associate editor of several journals including Proceedings of the International Association for Great Lakes Research. He has been an advisor and consultant to numerous agencies, municipalities, engineering firms and riparian owners on the Illinois shore. His special interests are bluff and shore erosion dynamics, effects of modern and ancient lake levels, coastal processes and the occurrence of fossil reefs in southern Lake Michigan for potential development as lake trout spawning grounds.

DONALD R. VONNAHME

DIVISION OF WATER RESOURCES
ILLINOIS DEPARTMENT OF TRANSPORTATION

Donald R. Vonnahme has served as director of the Division of Water Resources of the Illinois Department of Transportation since 1982. Prior to this, he was the division's deputy director from 1976 to 1982. He was office manager/design engineer for Metcalf & Eddy/AM&G from 1972 to 1976.

Mr. Vonnahme is a member of the Governor's Natural Resources Subcabinet, chairman of the Illinois State Water Plan Task Force, Illinois commissioner to the Ohio River Basin Commission, Illinois commissioner to the Upper Mississippi River Basin Association and Illinois commissioner to the Great Lakes Commission (chairman of the transportation and economic development committee).

In addition, Mr. Vonnahme also serves as a member of the board of directors of the Interstate Conference on Water Problems (vice chairman), member of the board of directors of the National Association of Urban Flood Management Agencies, Illinois staff member of the National Governors' Association--Water Management Committee and Transportation Committee, Governor's liaison to the St. Lawrence Seaway Development Corporation and member of the American Association of State Highway and Transportation Officials--Water Transportation Committee.

Mr. Vonnahme is a graduate of the University of Illinois. He received his bachelor of science degree in civil engineering in 1964 (specialities: hydraulics, hydrology and economics). He is a registered professional engineer in Illinois and Missouri.

GENERAL SESSION ON WATER QUANTITY

HENRY G. WILLIAMS
COMMISSIONER
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Today we face an immense challenge, "How do we manage and protect the water in the Great Lakes, water that according to the International Joint Commission is fully utilized?" There is no surplus, but rather a competition among users. Under these circumstances it is paradoxical that we should find the resource threatened, yet it is.

It is threatened because water dependent industry and agriculture as well as population growth is using it faster than it can be replaced. The evidence is everywhere. There are sink holes in Florida, water tables in Arizona that have dropped 400 feet in the last 50 years, and irrigation in the High Plains aquifer that consumes water 50 times greater than the recharge rate, a rate more than the entire flow of the Colorado River.

There are declines in lake levels, well yields and river flows. Without threatening the lake levels of the Great Lakes, only the renewable annual supply can be used, or approximately 1 percent of all the Great Lakes waters. The IJC has predicted that Great Lakes consumption could reach 1 million liters per second in 50 years if current practices continue. This could result in a drop in the levels of Lakes Erie, Huron and Michigan of 13 inches, and the flow of the St. Lawrence River would be reduced by 12 percent.

Furthermore, minor reductions in Lake levels would result in drastic consequences to Great Lakes fishing, shipping, utilities, tourism, recreational and water intensive industries.

And in California, the San Joaquin Valley has dropped 30 feet in some places, forever sealing the recharge value of the underlying soils. Even if the pumping stopped, the aquifer underlying the Valley could never recharge.

There was a time when practices and events like these examples may have meant little to us, but that complacency has ended.

It ended abruptly when the Power River Coal and Slurry Pipeline was proposed; when the call came for the transport of Lake Superior water to Wyoming.

It ended when the Corps of Engineers began an investigation of the High Plains aquifer that in part, studied the feasibility of diverting water from the Missouri River to recharge the aquifer.

It ended when the Supreme Court of the United States struck down Nebraska and New Mexico water laws prohibiting water diversions. In Nebraska, the U.S. Supreme Court struck down a statute, that prohibited the export of water

without reciprocation as an impermissible burden on inter-state commerce. In another decision, the Court found the need of a Texas city for drinking water was sufficient to override a New Mexico law prohibiting the export of its groundwater.

These events triggered an action-oriented program by the Council of Great Lakes Governors. This program did three things. First, it sought federal legislation to protect the Great Lakes Basin from diversion. Second, it urged the Great Lakes states and provinces to enact legislation which would prohibit diversions without the mutual consent of the other Basin states, provinces and the IJC. And third, it created a Task Force on Great Lakes Water Diversions. The Great Lakes Charter evolved from this Task Force.

The Task Force was created to evaluate the existing Great Lakes Compact and other institutional mechanisms to determine their relative abilities to strengthen the position of the states and provinces in regulating Great Lakes diversions.

During the Task Force's deliberations, it became apparent that existing legal protections had some loopholes. For one, Lake Michigan lies entirely within the United States. It is, therefore, not subject to the Boundary Waters Treaty. The U.S. Supreme Court decisions striking down states' water rights laws also provided big holes.

In view of these loopholes, the Great Lakes Charter seeks a position of greatest constitutional strength, based on a resource management and regulatory approach. While pointing out that water embargoes would be found unconstitutional if challenged, court decisions have provided guidelines to states seeking to enact sound, definable water legislation that can successfully protect their resources against exportation threats. It is obvious that we must manage and use our waters in the same manner that we would regulate and prohibit others. Such an approach would meet a legal test of even-handedness.

The Great Lakes Charter lays the foundation to examine the means by which its members can strengthen their abilities to resist or regulate Great Lakes water diversions outside of the Basin. It also represents an unprecedented joint commitment of all eight Great Lakes Governors and two Canadian Premiers to the management of the Basin's resources and protection of the Great Lakes. It calls on its signatories to develop and maintain a common base of data on major uses of water from the Great Lakes Basin and to confer with each other in developing water conservation programs, to seek legislation in their respective jurisdictions to establish programs to manage and regulate interbasin diversions and consumptive uses, and to engage in a regional consultation process whenever a major new diversion or consumptive use is contemplated in their jurisdiction. The states and provinces would seek a mutually agreeable action on the proposed use.

The signatories would also be called upon to develop a cooperative water resources management plan, and encourage cooperative research.

The Charter lists several actions that each state and province should pursue towards implementation of the Charter. First, a Water Resources Management Committee must be appointed with 60 days of the effective date of the Charter. The Committee has been appointed, and I have been elected by the members to serve as Chairman.

Our Committee's tasks are specified in the Charter. The Committee has already met twice, and we have a schedule laid out to achieve our objectives. A process is underway to collect and assemble existing Great Lakes water use data and systems to exchange such information.

Generally, the Water Resources Management Committee will be working on the following activities: We will be evaluating existing information, including state, provincial, federal and international sources by purposes; reviewing data collection methods and purposes and formats; establishing accuracy standards and present inconsistencies; developing a regional data system; testing the system; and developing and providing directions and financing for the system's use.

Another Charter commitment is to pursue the enactment of state legislation to assist in data and information collection of a Basinwide Water Resources Management Program.

At a meeting yesterday of the Water Resources Management Committee, it was heartening to learn that several states have already enacted legislation to take steps to implement the Charter.

Another Charter action commits the states and provinces to formally initiate prior notice and consultation processes for stated amounts of withdrawals following development of procedures by the Water Resources Management Committee, and approval of these procedures by the Governors and Premiers.

Finally, the Charter calls for the development of a Basin Resources Management Program to commence upon formal approval by Governors and Premiers of the recommendations that will be submitted by the Water Resources Management Committee.

We face the challenge of managing and protecting the waters of the Great Lakes ... waters that are being threatened by a rate of use that is greater than the rate of recharge. Protection and management of the Great Lakes must be based on constitutional strength based on a resource management and regulatory approach.

The Great Lakes Charter lays the foundation for examining ways to strengthen our protection of the Great Lakes. It is now up to the states and provinces to follow through on the steps called for by the Charter.

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WEATHER AND CLIMATIC EFFECTS ON LAKE LEVELS

STANLEY A. CHANGNON, JR., CHIEF EMERITUS
ILLINOIS STATE WATER SURVEY

Introduction

Climate is the major control over the levels of the Great Lakes, and climate affects all the Great Lakes in a very similar manner. The atmosphere provides the precipitation, the total water input to the lakes, and greatly influences the loss of water from the lakes through high rates of evaporation. Although this paper focuses on Lake Michigan and its climate factors, most of what is true about Lake Michigan and its climate is true for the other Great Lakes.

This paper first presents seven key truths about the climate of the Lake Michigan Basin, then illustrates how the lakes and the atmosphere interact. The values of the hydrologic cycle of Lake Michigan, and how ongoing shifts in the climate are affecting the lakes are presented. The paper concludes with speculations about future weather and climate conditions and their impacts on lake levels.

Climate Factors

Table 1 presents a list of seven major factors relating to the climate of Lake Michigan. The first factor, relating to climate controls, is the starting point. The presence and the greatness of the Great Lakes are largely due to the climate. The Great Lakes are located in a humid climate labeled "continental" by climatologists. A continental type climate occurs only in a central locale of a large land mass such as North America. The sun, through solar energy, is the principal factor controlling the regional climate, and the oceans play a large role since they cover 80 percent of the globe and store much of the solar energy, and affect the atmosphere considerably through the release of moisture and stored heat to the atmosphere. The size and shape of North America is a third climate control on the Lake Michigan Basin. The cold dry air originating over the northern parts of the continent, when interacting with the warm moist air from the Gulf of Mexico, provide contrasting air masses that sweep back and forth across the Great Lakes. The interaction of these air masses provides the storms and frequent precipitation that make the climate classified as "humid". As a result, the climate of Lake Michigan Basin is continental with warm to hot summers, cool to cold winters, large differences of precipitation with distance, 30 to 40 thunderstorms per year, and severe fall, winter and spring storm systems that produce high winds and heavy precipitation, including locally heavy snowfalls.

Table 1. Climate Factors and Lake Michigan

1. * Climate controls...the sun, the oceans, and land mass = air masses, and the lakes, too.
2. * Climate is always changing...glaciers and palm trees.
3. * Climate fluctuations in two ways...trends and variability.
4. * Climate affects Lake, and Lake affects climate.
5. * Do not discount influences of Chicago (and Milwaukee).
6. * Climate provides water and takes it away...an overwhelming force.
7. * Extremes are the norm...stand by, a record is always being broken.

Another interesting facet of the region's climate is the fact that the climate is always changing, as noted by the second factor in Table 1. The historical climate of the Basin has had extreme differences. At times glaciers up to a mile thick covered much of the Basin, and at other times the climate was tropical, and palm-like trees grew. This illustrates the fact that the climate has and can fluctuate considerably. Further, climate is always changing to some degree, a subject which will be addressed later in this paper.

The third factor illustrated in Table 1 addresses how the climate fluctuates. It can occur in two ways. First, are general trends, often labeled by climatologists as conditions are slowly becoming wetter and cooler, or drier and warmer, over decades and centuries. Another equally important facet of climate fluctation is year-to-year or in-season variability. At times, weather is "quiet" without many extremes occurring, either in temperatures or precipitation. As climate changes, we can move into eras of greater (or lesser) extremes and more variability from day-to-day, month-to-month, and year-to-year. We will examine how these two conditions are changing now in a later section of the paper.

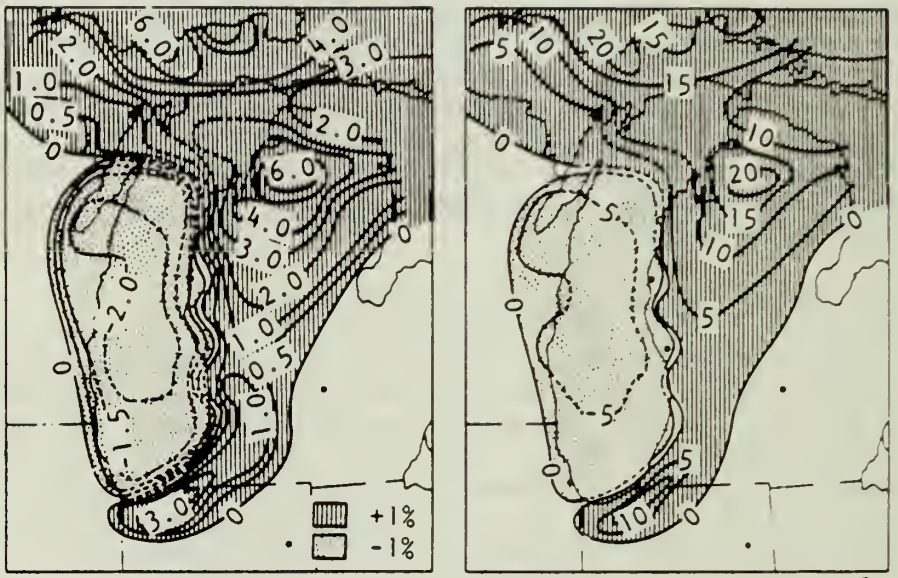
Interactions Between the Climate and Lake Michigan

The fourth factor shown in Table 1 relates to the interaction between the fact that climate conditions affect the lake, and in turn, how the lake affects the climate. We all recognize that the water supply of the lakes is largely controlled by the climate. Also, most residents of the Great Lakes are well aware that the lakes enhance winter snowstorms and produce major snow belts in the lee of each lake. All along the western side of lower Michigan, one finds a major snow belt with 15 to 60 inches of more snow occurring than would exist if there was no Lake Michigan.

The converse is true in summer, when the lake is relatively cool in relation to air temperature. Then, the lake suppresses clouds and precipitation, leading to less rain over the lake and in the immediate lee of the lake. In the fall when the lake temperatures are relatively warm, we get major increases in rainfall, thunderstorms, and hail principally in the lee of the lake in Michigan.

The net effect of the lake influences on climate produces a marked change in the annual average precipitation. Figure 1 reveals, both in inches of precipitation and percent change, hou much Lake Michigan alters annual precipitation. Over the lake and along the western shoreline there is less precipitation than would occur without Lake Michigan, with reductions anywhere from 1 to 8 percent. In the lee of the lake in lower Michigan, there is 5 to 20 percent more precipitation each year due to the lake. Suffice to say that Lake Michigan, like all the other Great Lakes, causes major changes in all weather conditions (Gatz and Changnon, 1976).

Table 1 lists a fifth climate factor, pointing to the influences of Chicago and Milwaukee on climate. Studies of lake influences, and those influences due to Chicago, have revealed that the city has a major influence on clouds



a. Changes, inches

b. Changes as a percent of no-lake-effect precipitation

FIGURE 1. CHANGES IN AVERAGE ANNUAL PRECIPITATION DUE TO LAKE MICHIGAN.

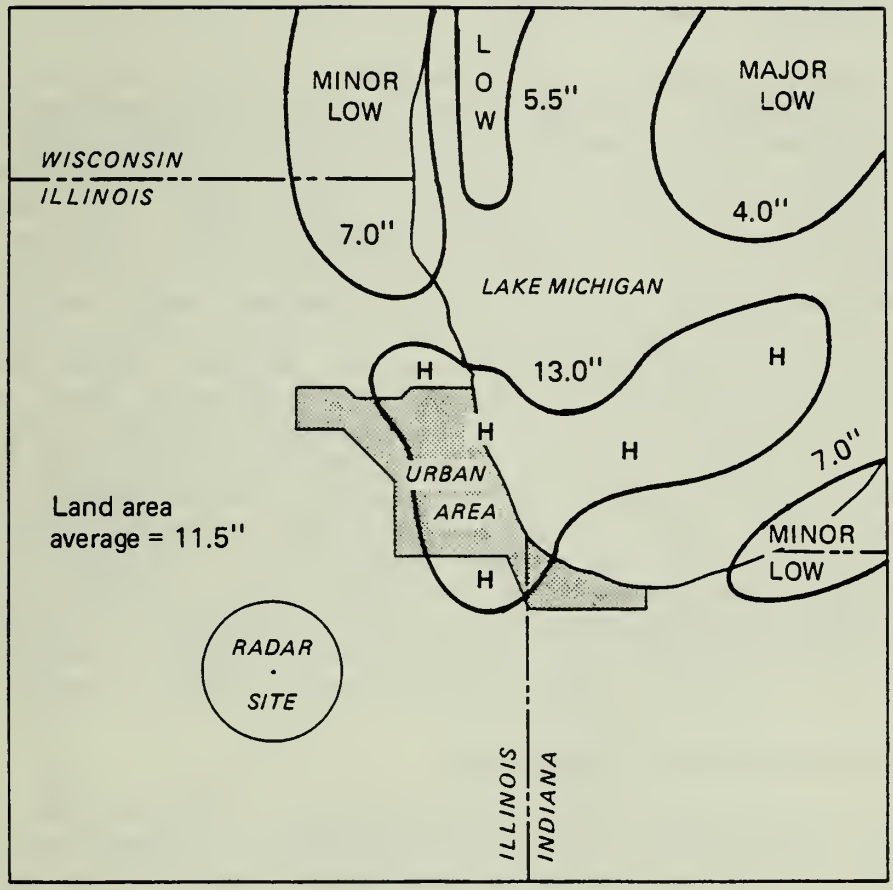


FIGURE 2. AVERAGE SUMMER RAINFALL (IN INCHES) BASED ON RADAR STUDIES OF THE CHICAGO REGION.

and precipitation conditions, particularly in summer (Changnon, 1984a). This influence, due to additional heating, releases particles and mechanical effects on air flow, and leads to increased cloudiness and intensification of rainfall under certain weather conditions. The net result is depicted in Figure 2, which is based on radar studies of precipitation in the Chicago and southern Lake Michigan region. This illustrates two key influences. First, one notes decreased rainfall along the western and southeastern shores away from Chicago (less than 7 inches compared to 11.5 inches further inland). And over the cold lake, precipitation decreases dramatically to 4 inches on the eastern portion of the lake; thus, lake influences are dramatic in reducing the average summer rainfall.

The second important climate finding revealed in Figure 2 relates to the considerable enhancement of summer rainfall by the Chicago metropolitan area. The 13-inch isohyet (a line drawn on a map connecting points receiving equal rainfall) reflects the maximum increase that begins over the city and extends well east, across and into the southern part of the lake. The urban influences obviously overwhelm the lake factors which inhibit precipitation. Without the City of Chicago, one would expect the area of less than 7 inches of rain found north of the city and along the western shoreline to extend all way around the southern end of the lake and to connect with an area of less than 7 inches found along the shore in northern Indiana. Calculations of the amount of added water produced by Chicago urban influences reveal that it represents approximately 30 percent of the average amount of water diverted at Chicago (3,200 cfs). Studies of effects by Milwaukee have not been made, but we suspect it too increases rainfall. A major point here, is that through major cities, man is having a major effect on the quantity of water in Lake Michigan, and that man's other changes of the landscape of the basin over the last 150 years have also altered the climate in ways that have changed the weather and the hydrologic cycle of the basin. That is, the climate is still the major control on the amount of water in Lake Michigan, but man has influenced the climate and thus on the amount of water.

Hydrologic Cycle of Lake Michigan Basin

Figure 3 is a schematic portrayal of the hydrologic cycle of Lake Michigan Basin showing average annual values of precipitation, evaporation, transpiration, runoff, and infiltration to the groundwater, both for the lake and for the land portion basin. The magnitude of these climatic inputs and outputs support climate factor No. 6 in Table 1. Lake Michigan is nearly 1/3 of the total basin, and examination of the precipitation and evaporation values in Figure 3 reveals that its values are very different from the land portion of the basin. As noted in Figure 1, there is less precipitation, by about 2 inches, on the lake, than on the land portion of the basin. Furthermore, evapotranspiration over the land portion basin is 20 inches, compared to an evaporation of 33 inches from the lake. Note that the lake's evaporation exceeds the amount of precipitation by 4 inches. The average flow of the excess water in the land portion of the basin includes approximaely 3 inches going into the groundwater and 8 inches going into the lake. Since the land portion of the basin is double the size of the lake, the total movement of water results in an inflow of 16 inches into the lake and an outflow of 24 inches of water from Lake Michigan into Lake Huron. Since the outflow from these lakes is controlled, additional precipitation or reduced evaporation in the basin leads to increased lake levels.

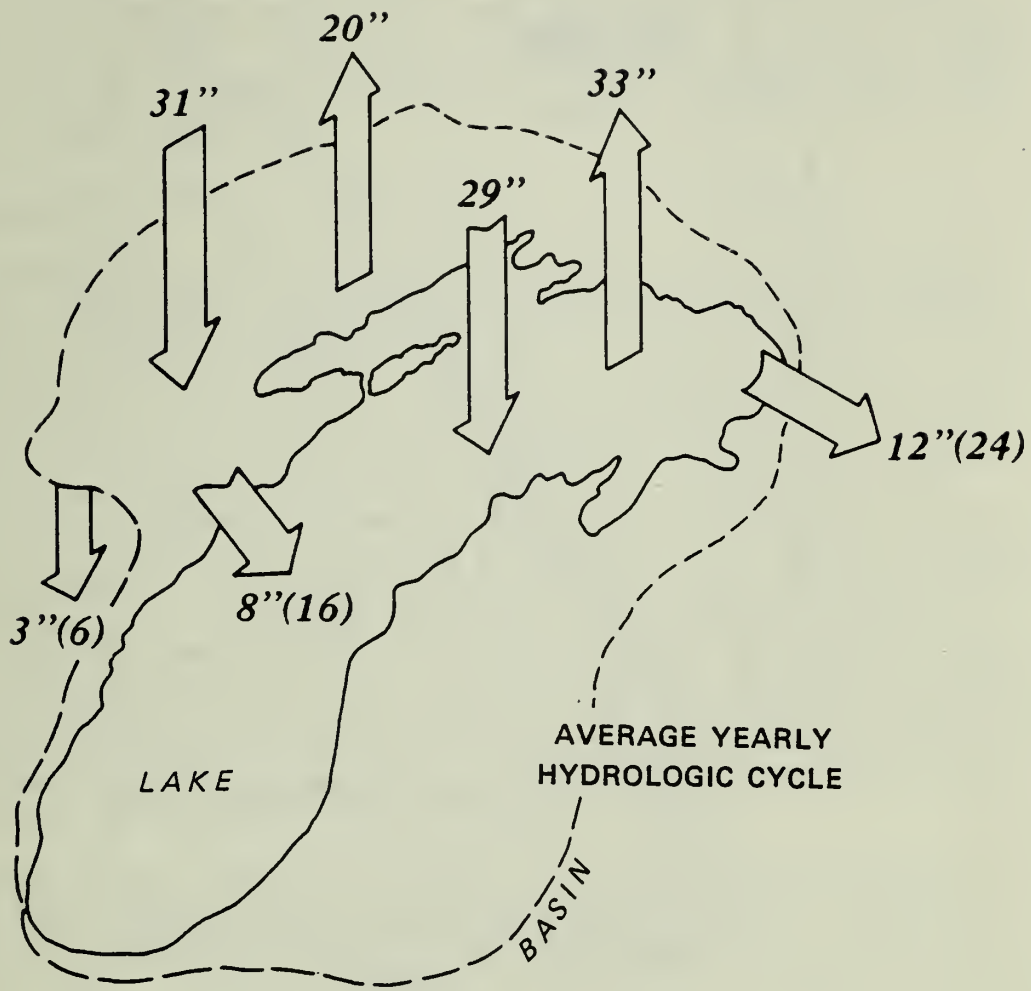


FIGURE 3. THE HYDROLOGIC CYCLE OF THE LAKE MICHIGAN BASIN, BASED ON AVERAGE VALUES (IN INCHES). SINCE THE LAND AREA IS TWICE THE SIZE OF THE LAKE, THE ACTUAL TOTAL VALUES OF RUNOFF AND GROUNDWATER INFILTRATION ARE DOUBLE THE AVERAGE AND ARE SHOWN IN PARENTHESIS.

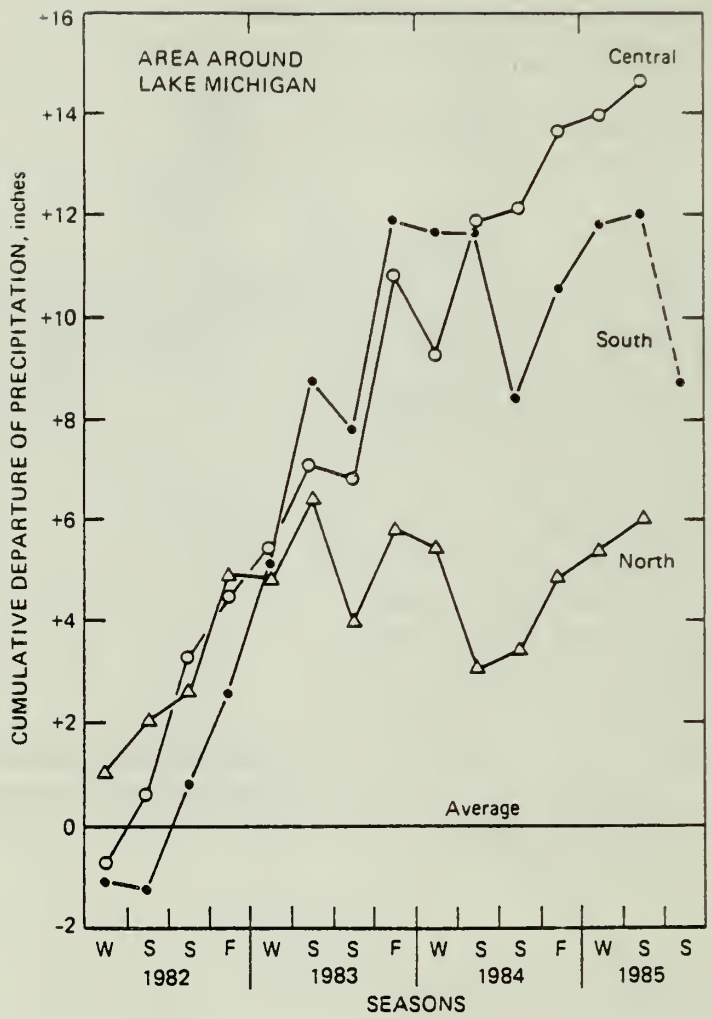


FIGURE 4. ACCUMULATED SEASONAL PRECIPITATION AMOUNTS (INCHES) FOR THE NORTH, CENTRAL, AND SOUTHERN LAND AREAS OF THE LAKE MICHIGAN BASIN FOR 1982-1985. ACCUMULATED PRECIPITATION COMPARED TO AVERAGE.

Figure 4 shows the accumulation of seasonal precipitation in the southern, central, and northern parts of the Basin over the last four years. The accumulation is in relation to the average, and shows how the wet conditions since 1981 have led to 15 inches of precipitation above average in the central portion of the basin with 12 inches in the south. This considerable departure above average was reflected in lake levels that rose and broke the records for March and April 1985. These extremes reflect an important aspect of the lake's climate, as noted in Factor 7 in Table 1. These precipitation departures raise the climate questions about change, continued wetness, and the causes for these conditions.

Climate Fluctuations

Efforts to interpret the Northern Hemisphere climate over the last 100,000 years, coupled with efforts to interpret lake levels over the last several thousand years, reveal several interesting facts. First, the current climate of the area is a part of a relatively warm cycle compared to what has occurred in the past 100,000 years. Secondly, when Lake Michigan was formed near the end of the great Pleistocene Epoch, with its major glaciers, the lake's level was much higher and drained through what is now the Illinois River. As the last (Wisconsin stage) ice sheet melted and the enormous weight was lifted, the land raised and the lakes began draining through Lake Erie and the St. Lawrence River, lowering the levels of Lake Michigan and the other lakes. However, Larson (1985) has shown that there were periods 1500 to 2000 years ago, when lake levels were 7 or 8 feet higher than they currently are, and during warm cycles about 1000 years ago, when the lake level was 4 to 5 feet lower than at present. The point of this discussion is that the climate of the Lake Michigan Basin has had great fluctuations (warm-cold, wet-dry), and these have been reflected in lake levels being considerably higher and lower than they currently are and what we have experienced since actual lake level measurements have been made since 1860.

The fluctuations of the climate of the Lake Michigan area over the last 140 years reveal several key factors that relate to the lake level. Figure 5 reveals that the temperature of the Basin warmed 3°C from 1850 to 1930, but since 1930 to 1935 it has been lowering and is now 1.5°C less than what it was in 1935 to 1940. The precipitation has fluctuated irregularly, but since 1965 the Basin has experienced the wettest 20 years of the past 140 years. Illinois records of cloud cover (Changnon, 1984b) reveal a general increase in cloud cover, particularly since 1940. The recent climate has provided more precipitation than in the past, and the cooler and cloudier conditions have effectively reduced the evaporation from the Basin so that we have had more water in - and less being removed - by natural processes.

Changnon's (1984b) study of climate change in Illinois reveals changes in other conditions relevant to Lake Michigan's high water levels. Over the last 20 years there has been a marked (35 percent) increase in the frequency of winter storm conditions. Also, analysis of summer storm conditions, as reflected in the occurrence of daily rainstorms producing 2 inches or more, reveals a marked (32 percent) increase in these since about 1960. Thus, storm conditions, which produce high winds and high wave conditions, have also increased during this period with a wetter, cooler, and cloudier climate.

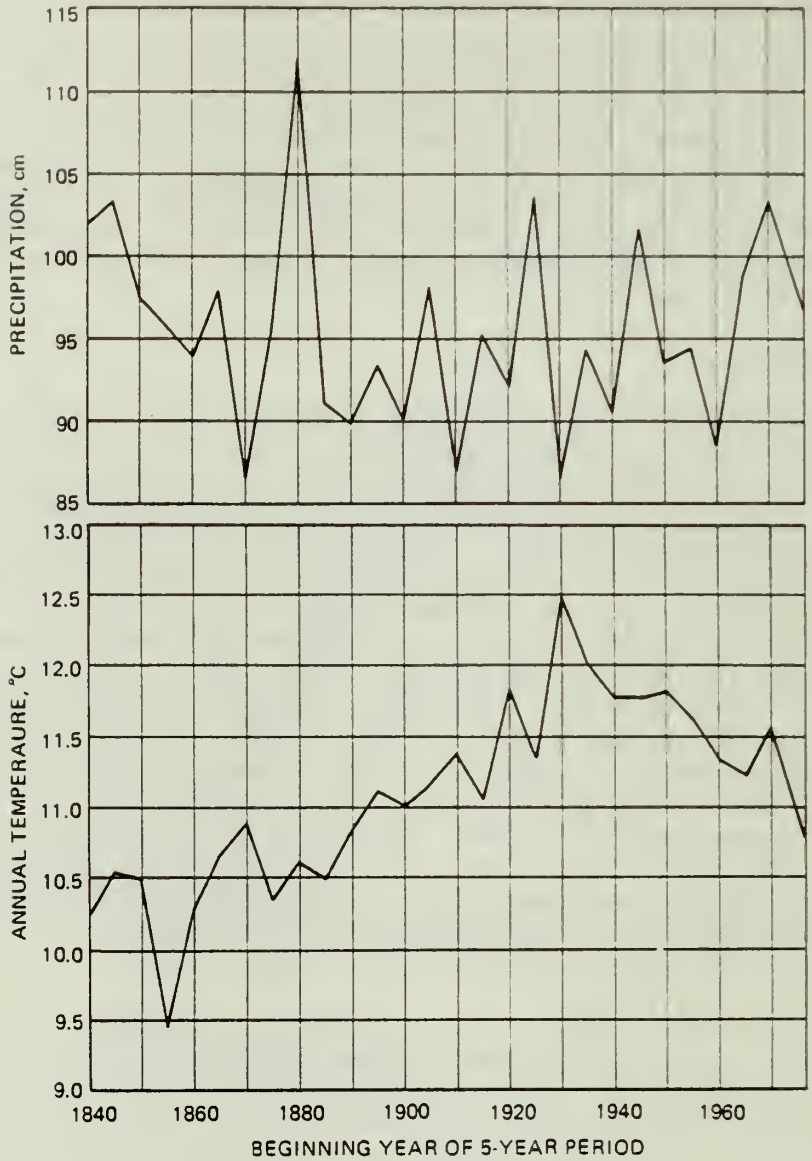


FIGURE 5. VALUES OF ANNUAL AVERAGE PRECIPITATION (CM) AND TEMPERATURE (°C) FOR ILLINOIS, BASED ON 5-YEAR BASE PERIODS, 1840-1980.

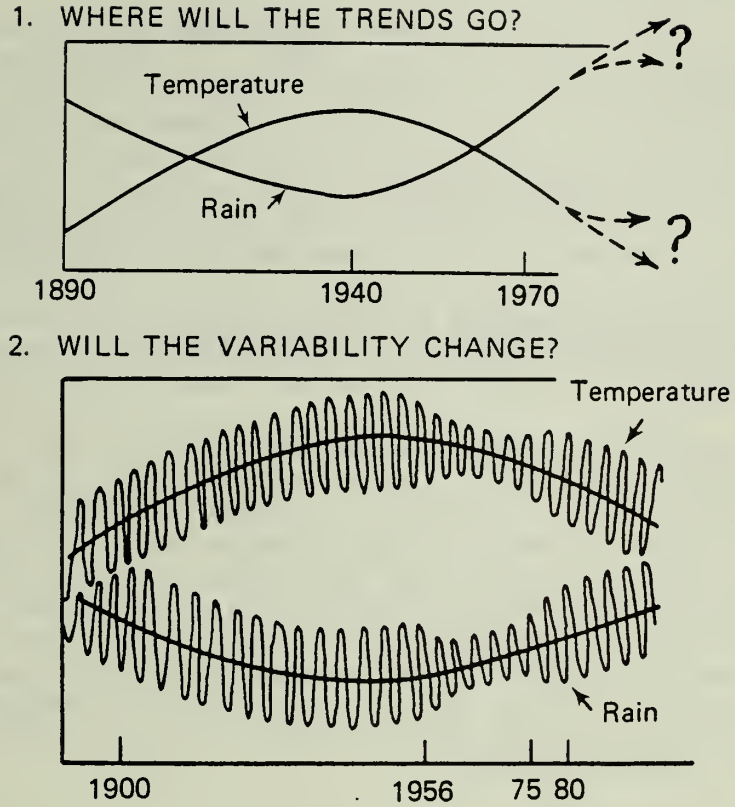


FIGURE 6. THE PAST TRENDS AND VARIATIONS AROUND THE TRENDS OF THE CLIMATE OF THE LAKE MICHIGAN BASIN, AND THE TWO BASIC QUESTIONS ABOUT THE FUTURE CLIMATE.

Summary and the Future Outlook

The foregoing discussion points to the fact that the level of Lake Michigan is closely related to the amount of water in the Basin, which is largely dependent on climate conditions: the precipitation is the input, and the evaporation and transpiration are the major outputs. Man has an influence on levels, both by control of lake outflows, and also by his inadvertent influences on the climate of the Basin. These human influences, in the net, appear to be adding water to the lake.

Assessment of the lake climate over time reveals that it is always changing, sometimes rapidly and at other times very slowly. Figure 6 presents the past and future questions about the two fundamental aspects of the climate of the Lake Michigan Basin that must be considered. As shown on Figure 6, the trends of the climate are to wetter and cooler conditions, as reflected by additional cloudiness. Figure 6 also directs attention to the other key aspect of climate: the variability around the trends. The Basin climate of the last 20 years is one of greater extremes than in the 1940-1960 period. This relates to the record lowest-lake levels (of the current era) that occurred in the early 1960s, and to the record highest levels that have occurred in 1973 and 1985. The greater frequency of storm conditions relates to additional cloudiness and precipitation and increased variability.

There has been considerable speculation about various man-derived effects that will alter the future climate. One of these is CO_2, or the "greenhouse" effect, which has been predicted to lead to the warming of the climate of the Great Lakes basin between 1 and 40°C (depending on the atmospheric model being used) by 2050. Others have postulated that the increased particulate loading in the atmosphere (also due to the burning of fossil fuels) will reduce solar energy and lead to cooling effects of 1 or 3°C by 2050. At this time, the record of the temperatures in North America over the last 100 years (Figure 5) do not indicate that either of these man-made influences is detectable at this time, and that the trends shown in Figure 6 are due to natural climatic forces.

So what will the future climate be? Considerable research is being conducted to improve climate forecasts, those defined as predictions of the general (not specific) level of temperatures and/or precipitation for the months, seasons, and 1 to 5 years ahead. Climate prediction based on physical understanding and modeling is still in an infantile stage. Water Survey researchers have worked on this issue, using climatological data as the basis of statistical prediction, and are able to show some skill in estimating future annual precipitation of Illinois as trending either up or down. At this time, these climatologically based outlooks for Illinois indicate a continuing trend to wetter and cooler conditions over the next few years.

Continuation of current trends, at least until another major reversal occurs, such as that occurred in the 1930s when the climate ended a warming and drier trend, and shiftd to a cooler and wetter one, will produce a cloudier, wetter, and a cooler climate for the Lake Michigan Basin. Hence, lake levels will remain high. Furthermore, the continuing trend for increased storminess

indicates there will be more high wave action and storms that will produce considerable shoreline damage. Those who must plan and deal with high lake levels and shoreline protection can only plan and operate under the premise, from the climate perspective, that high levels and storminess will persist for several more years.

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LAKE LEVEL TRENDS AND INTERBASIN DIVERSIONS

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LAKE HYDROLOGY, GREAT LAKES ENVIRONMENTAL RESEARCH LABORATORY
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

The Great Lakes are one of our nation's greatest water resources containing 95 percent of the nation's and 20 percent of the world's fresh surface water. The prime measure of the water quantity of the Great Lakes is the lake levels of the individual Great Lakes and Lake St. Clair. Due to the recent record high lake levels this past spring, there has been renewed interest in lake level trends and the factors accounting for the current high water levels. Many riparian interests are particularly concerned about possible storm damage and flooding as we head towards the fall storm season on the lakes.

There is a major tendency to think of Great Lakes water levels in terms of extremes rather than of normal conditions. Within recent memory we have had the record low lake levels of 1964. This resulted in docks sitting out of the water, insufficient depths for navigation in many harbors and channels, and greatly reduced recreational opportunities. These low levels were followed nine years later, in 1973, by record high lake levels with resultant flooding, shore damage and erosion. The lake levels have remained high over the intervening period, and this spring new record highs were once again set on Lakes Michigan-Huron, St. Clair and Erie.

In this presentation I will discuss the physical characteristics of the Great Lakes from a water quantity perspective, examine the types of natural lake level fluctuations and their causes, and compare the natural fluctuations with the effects of currently existing diversions into and out of the system. I will briefly present some lake level effects of hypothetical interbasin diversions and conclude with an outlook for the immediate future.

PHYSICAL SYSTEM

The Great Lakes basin (see Figure 1) contains an area of approximately three hundred thousand square miles. The most upstream, and largest lake, is Lake Superior. Lake Superior is completely regulated according to a regulation plan, Plan 1977, under the auspices of the International Joint Commission. The lake has two interbasin diversions of water into the system from the Hudson Bay Basin, the Long Lac and Ogocki Diversions. The water flows from Lake Superior through the locks and compensating works at Sault St. Marie, and down the St. Marys River into Lake Huron where it is joined by water flowing from Lake Michigan. Lakes Michigan and Huron are considered to be one lake, hydraulically, because of their connection through the Straits of Mackinac. The second interbasin diversion takes place from Lake Michigan at Chicago. Water is diverted there from the Great Lakes to the Mississippi River Basin. The water flows from Lake Huron through the St. Clair River, Lake St. Clair and through the Detroit River system into Lake Erie. From

Lake Erie the flow is through the Niagara River and Welland Diversion into Lake Ontario. The Welland Diversion is an intrabasin diversion bypassing Niagara Falls and is used for navigation and hydropower. There is also a small diversion into the New York State Barge Canal System that is ultimately discharged into Lake Ontario. Lake Ontario is also completely regulated in accordance with Regulation Plan 1958D. The outflows are controlled by the Moses-Saunders Power Dam between Massena, New York and Cornwall, Ontario. From Lake Ontario the water flows through the St. Lawrence River to the Gulf of St. Lawrence and the ocean.

LAKE LEVEL FLUCTUATION AND TRENDS

There are three primary types of lake level fluctuations: annual lake levels, seasonal lake levels and short-period lake level changes due to wind setup and storm surge. The annual lake levels (see Figure 2), as represented from 1860 to present, show the long term variability of the system. Of particular interest is the fall in the levels of Lakes Michigan and Huron occurring in the mid-1880's from which the lakes never recovered. This probably resulted from dredging for deeper-draft navigation in the St. Clair River. The record highs in 1952 and 1973 and record lows in 1935 and 1964 are readily apparent. There is an overall range of about 6 ft. in the annual levels. These are the fluctuations which result in most of the variability leading to the record high and low lake levels.

Superimposed on the annual levels are the seasonal cycles (see Figure 3). Each of the lakes undergoes a seasonal cycle every year. The magnitude depends upon the individual water supplies. The range varies from about 1.5 ft. on Lakes Erie and Ontario to about 1.0 ft. on Lake Superior. In general, the seasonal cycles have a minimum in the winter, usually January or February. The levels then rise due to increasing water supplies from snow melt and spring precipitation until they reach a maximum in June for the smaller Lakes, Erie and Ontario, and September in the case of Lake Superior. When the net water supplies diminish in the summer and fall, the lakes begin their seasonal declines.

The final type of fluctuation, which is common along the shallower areas of the Great Lakes, particularly Lake Erie, Saginaw Bay, and in some cases on Green Bay, are storm surges and wind set-up. Under these conditions, when the wind is blowing along the axis of a shallow lake or bay, a rapid difference in levels occurs and builds up between one end of the lake and the other. This difference can be as large as 16 ft. for Lake Erie. These storm conditions, when superimposed on high lake levels, cause most of the damage along the Great Lakes shoreline.

Looking in more detail at the past trends in lake levels, along with the more recent conditions for Lake Michigan-Huron, we see a steady progression of changes in the lake levels with time. At the bottom of Figure 4 are the record low lake levels for each month that were set primarily in 1964. Proceeding upward we have the 40-year period from 1900 to 1939. For the next 40 years, from 1940 to 1979, the lake is at a still higher level. Taking the 11-year period from 1970 to 1980, we see that the lake is higher

yet, followed by the record highs set in 1973. This year, record levels were set in April and May on Lakes Michigan-Huron, St. Clair and Erie.

Also of interest are the changes in the fall between Lake Michigan-Huron and Lake Erie (see Figure 5). The difference in water levels between the two lakes has decreased markedly over the past 120 years. Most of the decrease in the early years was due to the change discussed earlier in the mid-1880's. There have also been several other changes in the St. Clair River including sand and gravel dredging between about 1908 and 1924, a 25-ft. navigational project in the mid-1930's, and a 27-ft. navigation project in the late 1950s and early 1960s. All of these projects have tended to lower Lake Michigan, which has resulted in less fall between Lake Michigan-Huron today than there was 100 years ago. Without these changes, Lake Michigan-Huron would be approximately 1.5 ft. higher than it currently is today.

It is interesting to compare the impacts of the existing diversions on lake levels, Table 1, with the natural lake level fluctuations shown. This enables a comparison of man's impacts with the natural fluctuations. The Long Lac and Ogocki Diversions average about 5600 cfs. They raise Lake Superior by about 0.21 ft., Lake Michigan-Huron by 0.37 ft., Lake Erie by 0.25 ft., and Lake Ontario by 0.22 ft. The Chicago Diversion out of the system averages about 3200 cfs and lowers Lake Michigan-Huron by 0.21 ft., lowers Lake Superior by 0.07 ft., Lake Erie by 0.14 ft., and Lake Ontario by 0.10 ft. The Welland Canal, which bypasses Niagara Falls, averages about 9400 cfs and lowers Lake Superior by about 0.06 ft., Lake Michigan-Huron by about 0.18 ft., Lake Erie by 0.44 ft., and has no effect on Lake Ontario. The combined effect on the lakes ranges from a plus 0.11 ft. for Lake Superior to a -0.33 ft. for Lake Erie. The combined effect on Lake Michigan is only -0.02 ft. and on Lake Ontario 0.08 ft. The diversion effects are therefore small in comparison with the 1.5-ft. seasonal cycle and the 6-ft. range of the annual variations.

The small effects of the diversions along with the long response time of the system illustrate why diversions are not readily adaptable for lake regulation. Due to the large size of the Great Lakes system, it responds very slowly to man-induced changes. This is illustrated by the length of time it takes from the start of a hypothetical diversion on Lakes Michigan and Huron until the ultimate effect of that diversion is reached on Lakes Michigan-Huron and Erie. It takes approximately three to three and one-half years to achieve 50 percent of the ultimate effect and 12 to 15 years to get 100 percent of the effect. Following Murphy's laws, by the time you would achieve a 50 to 80 percent of the desired effect when changing a diversion to alleviate a prevailing lake level condition, the levels condition would likely tend to the extreme in the opposite direction.

HYDROLOGIC CYCLE

The primary process that determines the lake levels is the hydrologic cycle of the Great Lakes Basin. For Lake Michigan-Huron, there are three major sources of water: precipitation over the lake surface, precipitation on the land basin which results in runoff into the lake, and inflow from the St. Marys River.

Based upon current studies, the inflow from groundwater is assumed to be negligible. The outflows consist of evaporation from the lake surface, flow through the St. Clair River, and flow through the Lake Michigan Diversion at Chicago. The imbalance between the inflow and outflow results in the lake levels either rising if there is more inflow than outflow, represented by a positive change in storage, or falling if there is more outflow than inflow represented by a negative change in storage.

Variations in air temperature also influence lake level fluctuations. At higher air temperatures, plants tend to use more water, resulting in more transpiration and higher rates of evaporation from the ground surface. This yields less runoff for the same amount of precipitation than would exist during a low temperature period when there is less evaporation and transpiration. The annual mean air temperatures around the perimeter of the Great Lakes since 1900 (Figure 6) indicate three distinct temperature regimes: a low temperature regime from 1900 to 1929, a higher temperature regime from about 1930 to 1959, and an additional low regime from 1960 through the present period. The difference between the previous and current regime is a drop of about 0.6°C.

The factor causing the major long-term variations in lake levels is precipitation, represented by the combined precipitation over the Lakes Michigan-Huron, St. Clair, and Erie basins using a three-year, non-centered mean. The long-term mean is based on the 1900 through 1979 period. The three year non-centered mean correlates very well with the annual lake levels. From 1900 through 1940, a low precipitation regime predominated with the majority of the years falling below the mean. From about 1940 to date a high precipitation regime has existed. Of particular interest are the high precipitation in the early 1950s, the low precipitation in the early 1960s that led to the record lows and a very high, consistently high precipitation regime from the late 1960's through the present time. For the period 1940 through 1979, the precipitation averaged about 6 percent higher than the precipitation from 1900 through 1939.

The excellent correlation between the precipitation and water levels can be observed by superimposing the annual precipitation on the annual Lake Michigan-Huron water levels (Figure 7). The precipitation tends to lead the water levels by approximately one year, as shown here by the 1929 high's, the 1935 low's, and the 1952 high's. In particular, you can see the results of the last 15 years of high precipitation resulting in very high water levels; thus the continuing high levels are the result of the increased precipitation regime since 1940, coupled with the lower temperature regime since 1960.

CURRENT CONDITIONS

Let us now proceed to the causes of the current record high levels. During December of 1984 we had much higher than normal precipitation throughout the Great Lakes Basin. In addition, we also had warmer air temperatures, which meant that the precipitation fell as rain rather than snow, giving a fast runoff into the system and causing the lakes to slow their annual decline. This was followed by continued high precipitation during January of 1985. In February of 1985 we continued with much higher precipitation than normal, ranging as much as 100 percent higher than normal in some parts of the basin.

This was followed by a very wet March. A major spring snow melt also occurred during the last week in February compounding the problem. On February 18 there was a large snow cover throughout the Great Lakes Basin. One week later most of the snow was gone from the southern part of the basin. This snow melted and ran off quickly into the lakes causing the levels to rise. Fortunately, in April, somewhat drier conditions occurred through most of the basin.

The results of these conditions are shown (Figure 8) as they affected the water levels. The daily water levels for Lakes Erie, St. Clair, and Michigan-Huron are shown along with the record monthly mean levels established during 1973. At the start of the year, the lake levels were below the record levels. The effect of February snow melt is shown by the sudden rise in levels of Lakes Erie and St. Clair. The lake levels began exceeding the record levels in March. Heavy rains on the southern portion of the basin occurred in late March and early April, which resulted in Lakes Erie and St. Clair setting new record highs in April. Lake Michigan-Huron also set record high levels, but rose at a much slower rate due to its very large water surface, which is roughly 45,000 sq. mi. The record high levels continued in May, but due to the dryer conditions on the basin, no June records were set. At the present time, we are just below the record levels for September set in 1973.

A long-term perspective on lake levels is illustrated by 7000 years of Lake Michigan water levels (Figure 9) reconstructed through geologic and archaeologic evidence by Curtis Larson (Larson, 1985) under work sponsored by the Illinois Geologic Survey. Looking at just the last 2500 years, during which time Lake Michigan and Huron were in their current state, we can see major lake level fluctuations. Of particular interest is the fact that during most of this time the levels were much higher than they are today. The other point that this figure illustrates is the relatively small amount of historical measured data that we have, 120 years, as compared with 7000 years of past events. This provides additional perspective and indicates that the lake levels in the future could go through a considerably larger range than we have experienced lately. Conditions back several thousand years ago were not necessarily the same as today due to isostatic rebound and uplift during the intervening time. But in general this provides us with additional perspective on possible conditions we may experience in the future.

INTERBASIN DIVERSIONS

Additonal interbasin diversions is a highly controversial issue at the present time around the Great Lakes. In this brief discussion, I will present the effects on lake levels of three hypothetical interbasin diversions. Possible use of Great Lakes water outside the basin could be for flow augmentation for navigation, energy uses such as synfuels or pipelines, agriculture and aquifer recharge, and for municipal water supplies. A small pipeline project such as the Powder River coal slurry pipeline would require 5 to 8 cubic feet per second of water and would have no measurable impact on lake levels. A synfuels project, highly unlikely at this time, could require approximately 800 cubic feet per second and result in lake level lowerings of .04 to .06 ft. A major agricultural or aquifer recharge project could

require 10,000 cubic feet per second and would result in lake level decreases ranging from 0.4 feet on Lake Erie to 0.7 feet on Lake Michigan-Huron. It should be emphasized that these are hypothetical projects and are used for illustration only.

CONCLUSIONS

As we enter this fall storm season, the Great Lakes are experiencing near record high lake levels, making it highly likely that riparian interests will experience continued flooding, erosion, and shore damage. Based upon the persistence of the current high precipitation and low air temperature regimes, it is likely that the current high lake level regime will continue for the next several years. It is also important to keep in perspective that while we have ranges in annual lake levels of 4 to 6 feet, and additional short-term effects on the order of 7 or 8 feet, the effects of man on the system are relatively small, on the order of a couple of tenths of a foot. Therefore, man can have relatively little impact in bringing about major reductions of the existing high lake levels.

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REFERENCE

Larsen, Curtis E., A stratigraphic study of beach features on the southwestern shore of Lake Michigan: new evidence of holocene lake level fluctuations. Environmental Geology Notes 112. Illinois State Geological Survey. Champaign, Illinois.

FIGURE CAPTIONS

Figure 1. Great Lakes Basin.

Figure 2. Annual Great Lakes Water Levels.

Figure 3. Great Lakes Seasonal Cycle.

Figure 4. Lake Michigan-Huron Level Trends.

Figure 5. Fall Between Lake Michigan-Huron and Lake Erie.

Figure 6. Great Lakes Annual Air Temperature.

Figure 7. Annual Great Lakes Precipitation and Lake Michigan-Huron Levels.

Figure 8. January-May, 1985 Daily Lake Levels.

Figure 9. Late Holocene Lake Levels in Southern Lake Michigan. Curtis Larson, Environmental Notes 112, ISCS, 1985.

Figure 10. Impact of Existing Diversions on Lake Levels.

Figure 1. Great Lakes Basin.

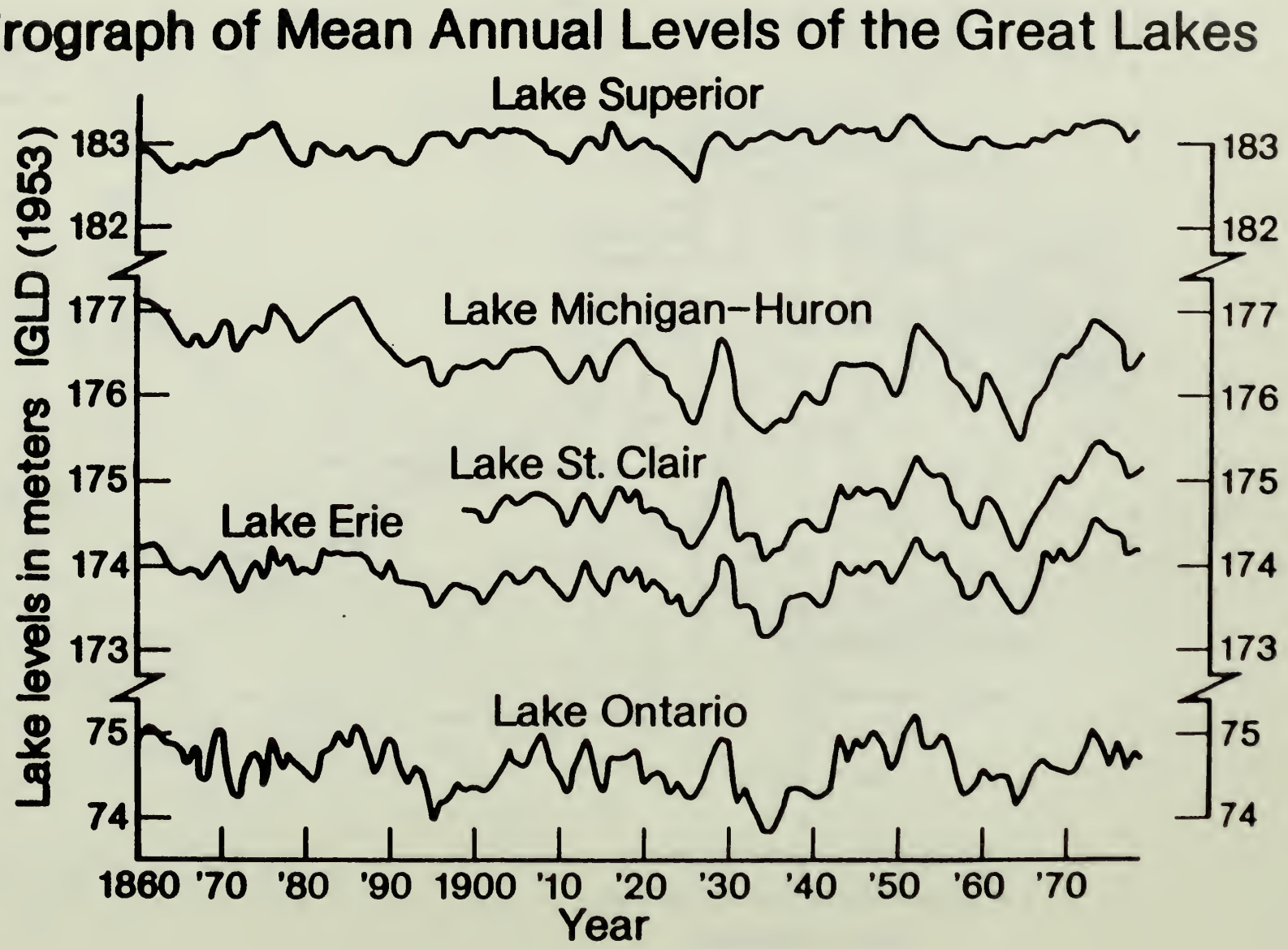

Figure 2. Annual Great Lakes Water Levels.

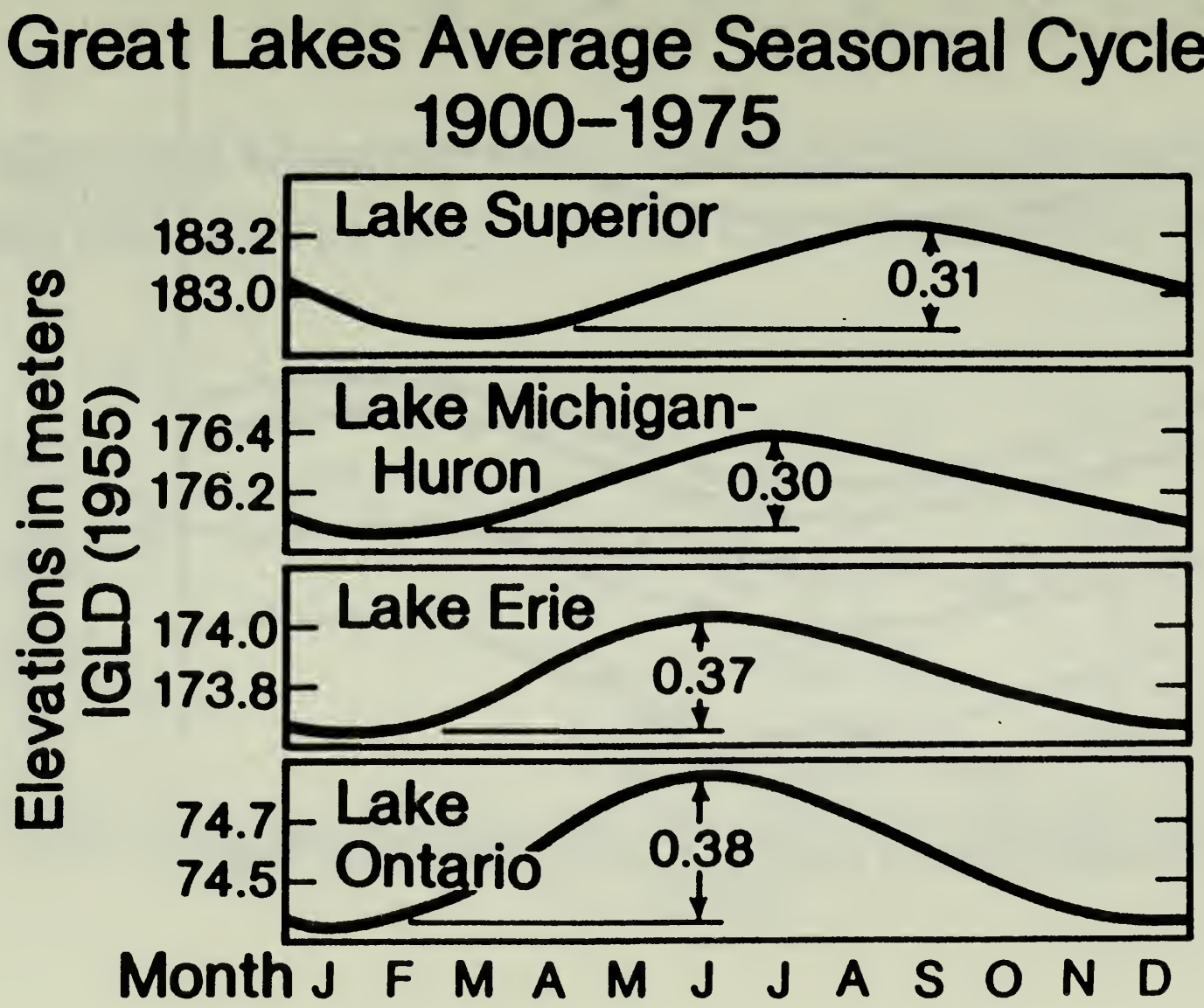

Figure 3. Great Lakes Seasonal Cycle.

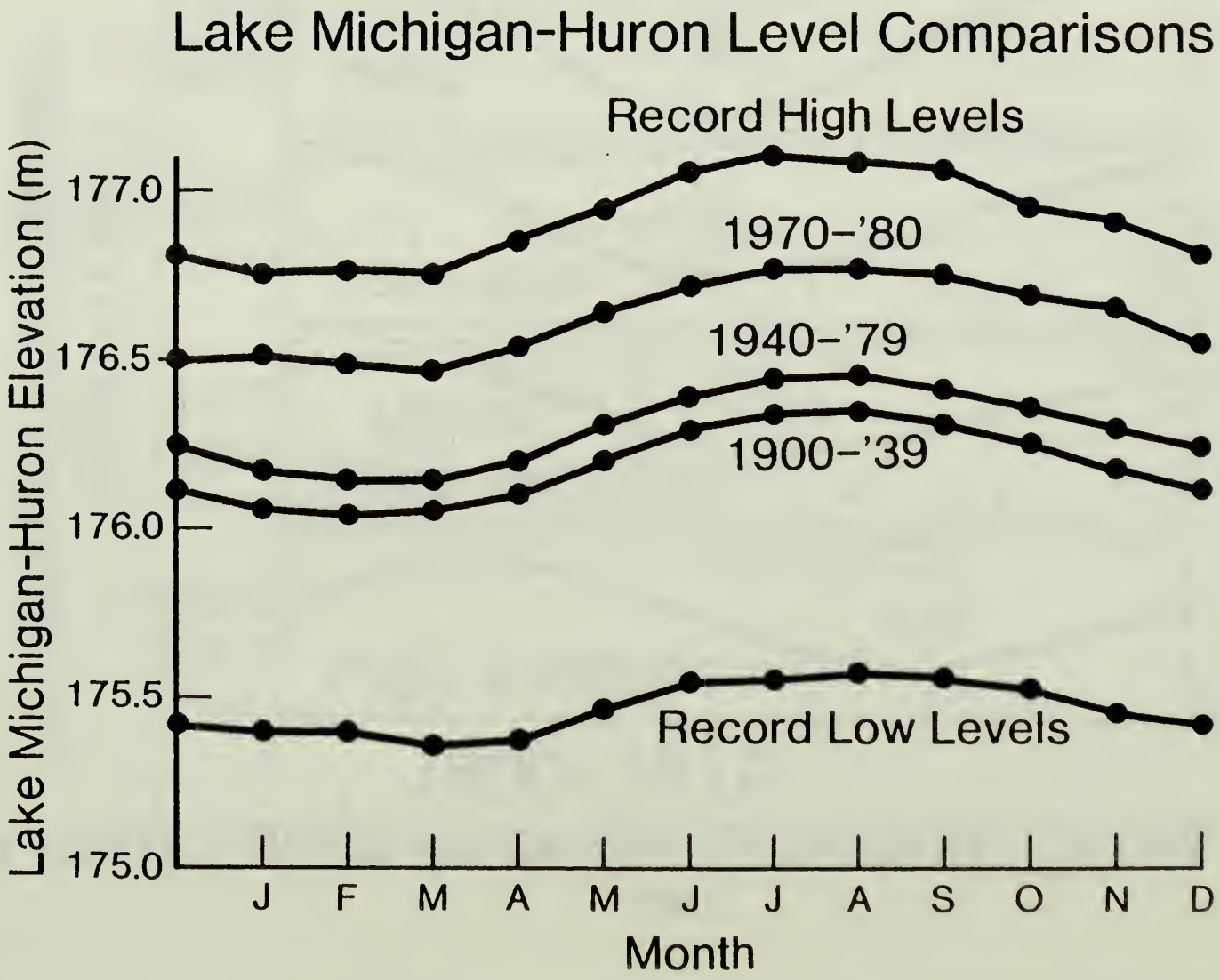

Figure 4. Lake Michigan-Huron Level Trends.

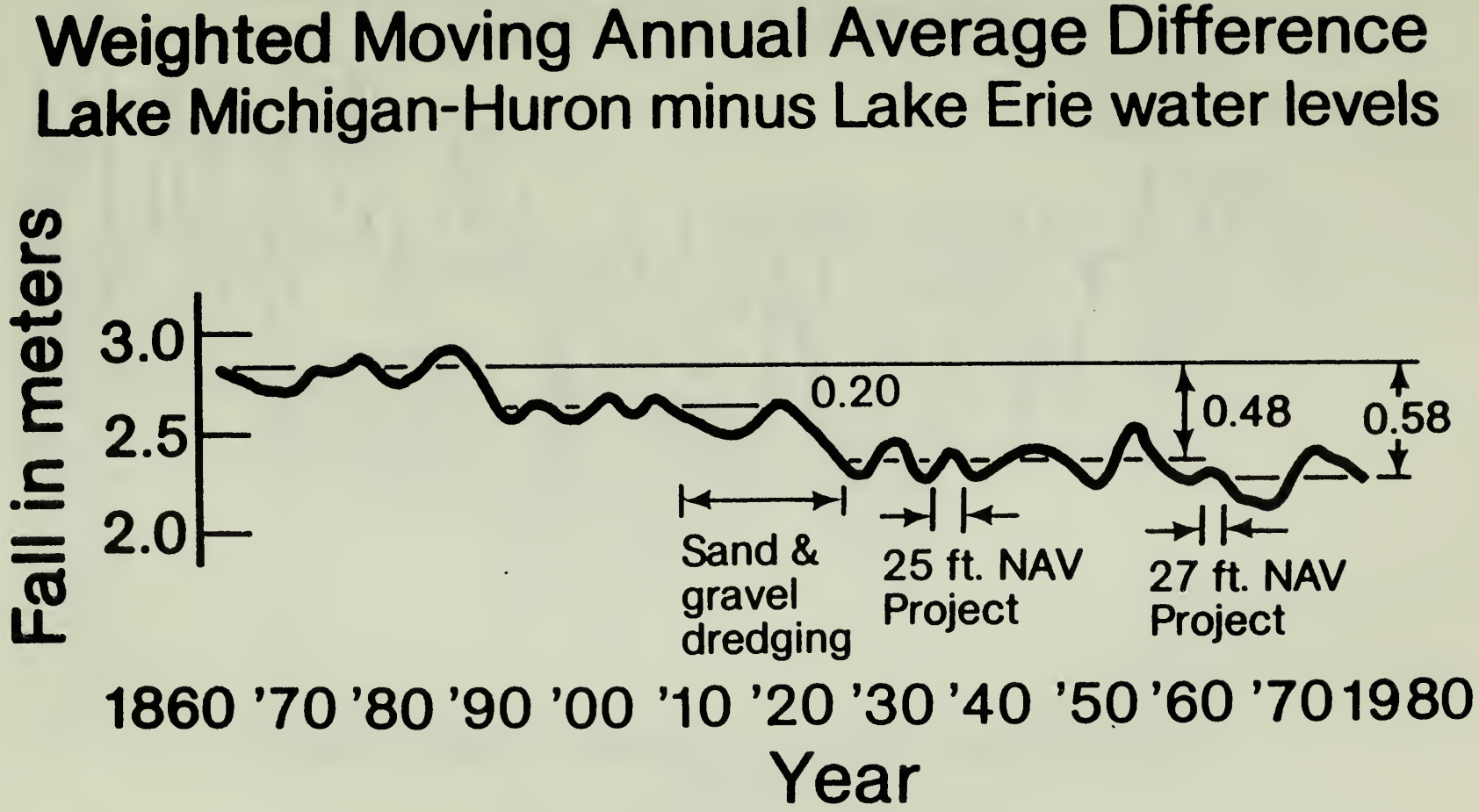

Figure 5. Fall Between Lake Michigan-Huron and Lake Erie.

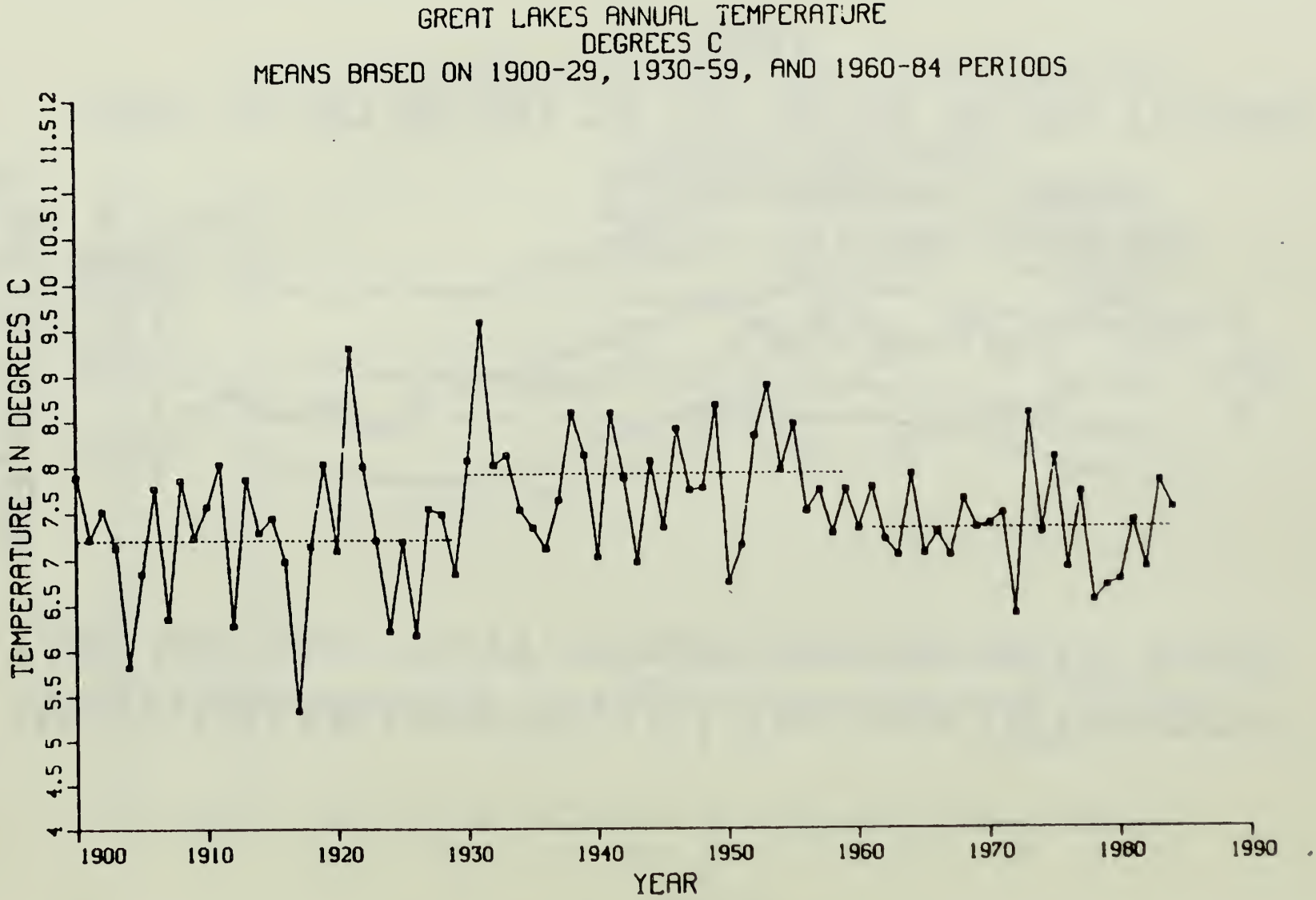

Figure 6. Great Lakes Annual Air Temperature.

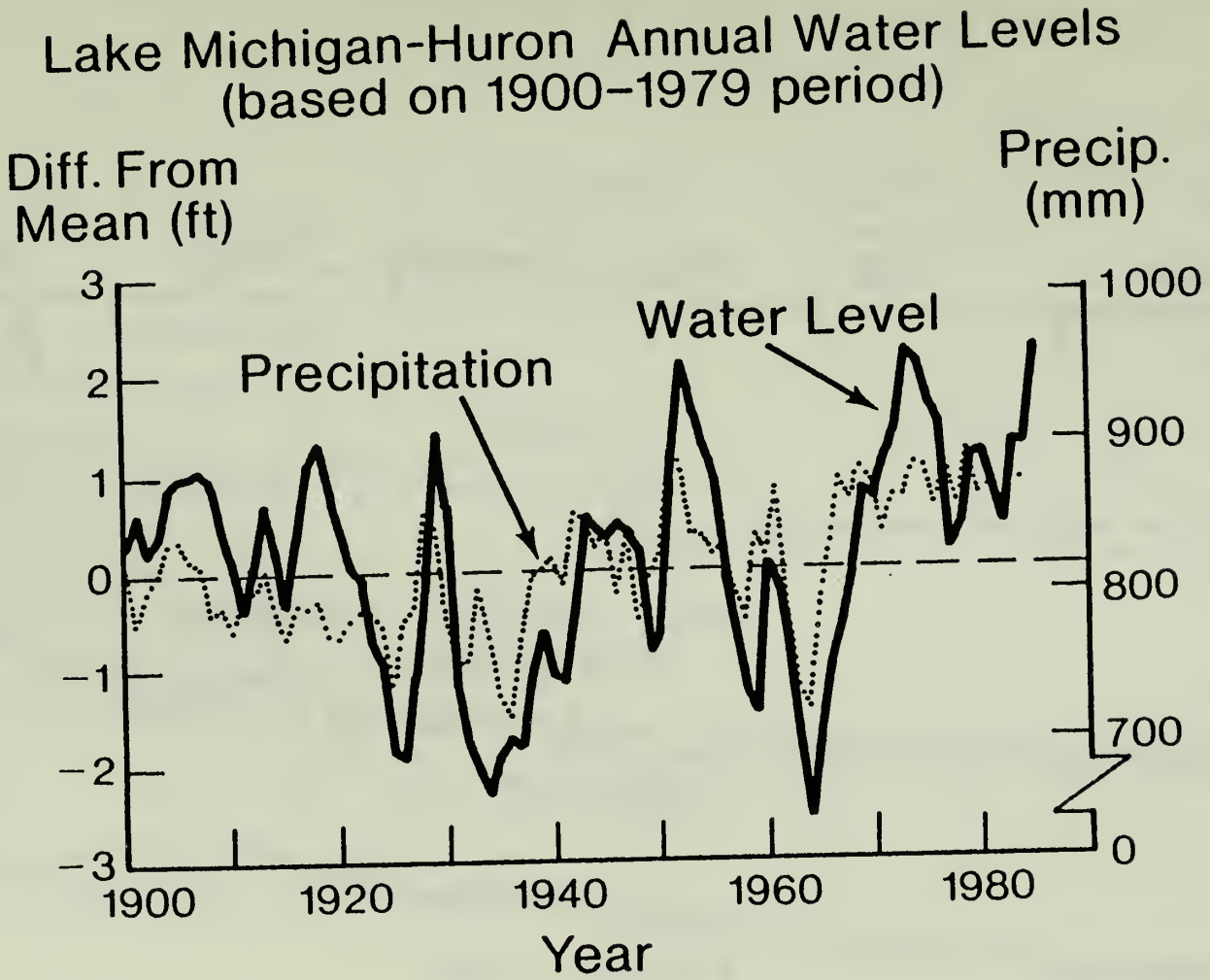

Figure 7. Annual Great Lakes Precipitation and Lake Michigan-Huron Levels.

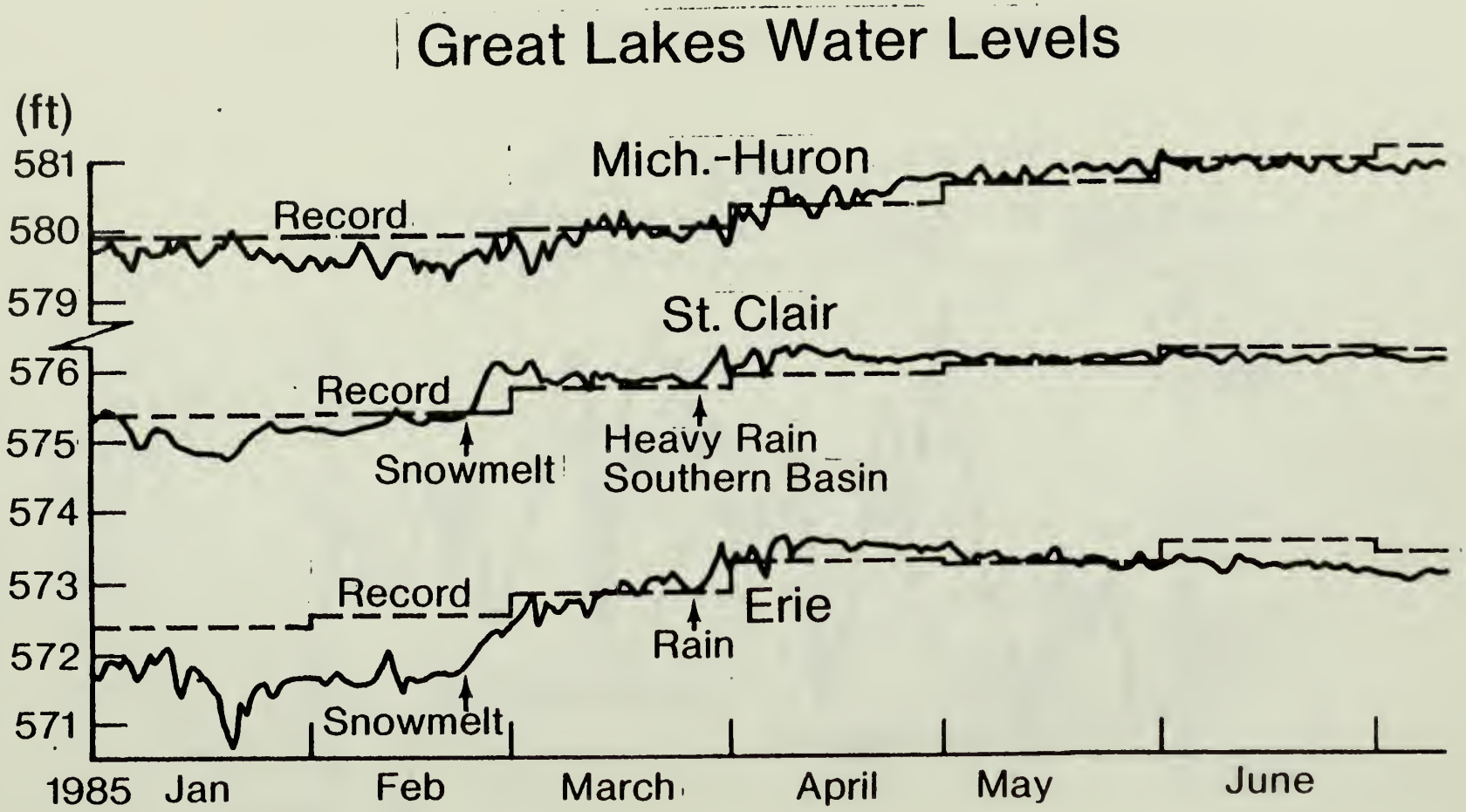

Figure 8. January-May, 1985 Daily Lake Levels.

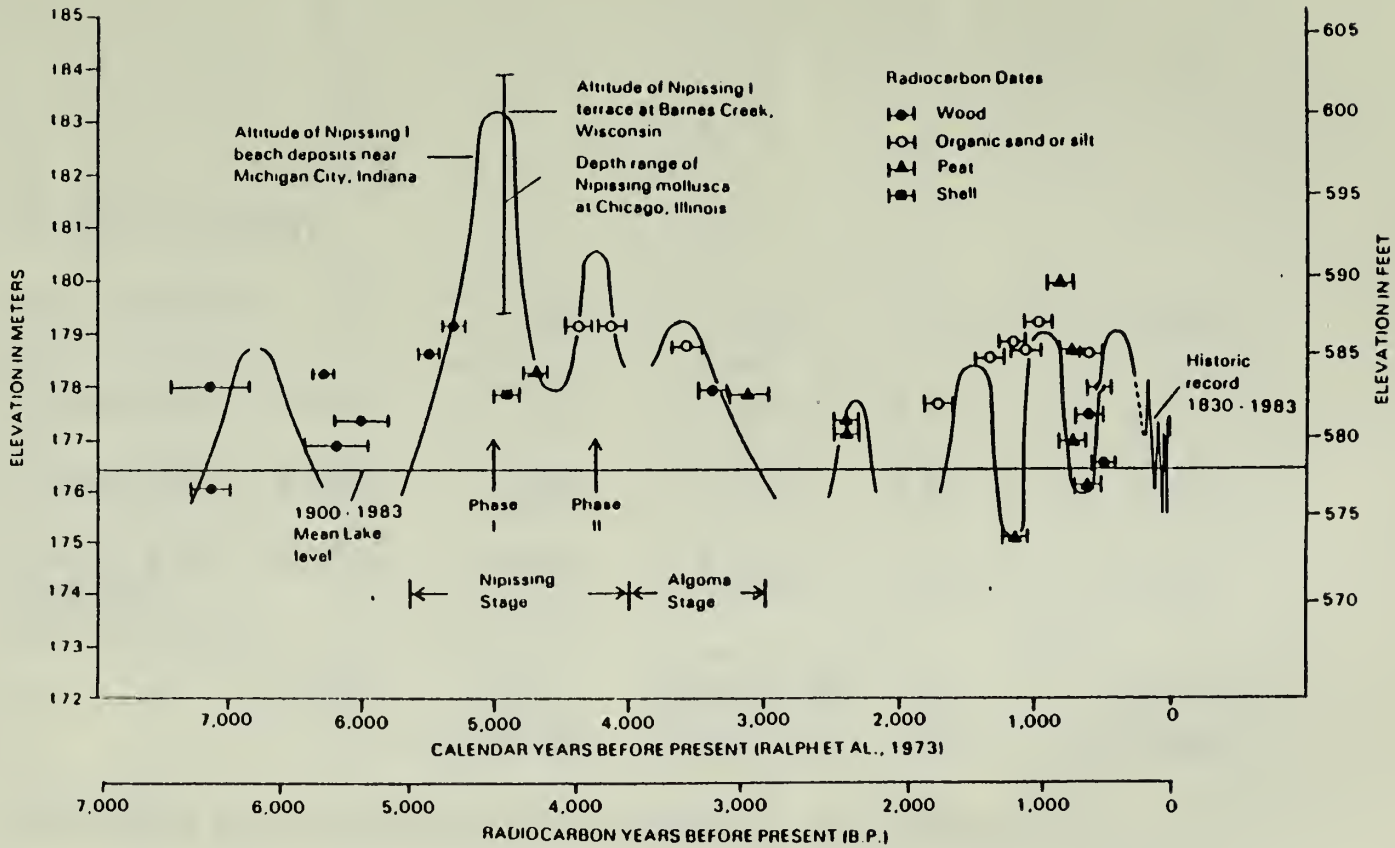

Figure 9. Late Holocene Lake Levels in Southern Lake Michigan.

From Curtis Larsen, Illinois Geological Survey (Sponsor)

Impact of Existing Diversions on Lake Levels

	Amount (cfs)	Superior (ft)	Michigan-Huron (ft)	Erie (ft)	Ontario (ft)
Ogocki-Long Lac	5 600	+0.21	+0.37	+0.25	+0.22
Chicago	3 200	−0.07	−0.21	−0.14	−0.10
Welland	9 400	−0.06	−0.18	−0.44	0
Combined		+0.07	−0.02	−0.33	+0.08

From IJC (1985)

Figure 10. Impact of Existing Diversions on Lake Levels.

LAKE LEVELS AND SHORELINE PROTECTION

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STRATIGRAPHY AND SUBSURFACE GEOLOGY SECTION
ILLINOIS GEOLOGICAL SURVEY

Illinois has a shore that consists on the south of about 23 miles of close urban shoreline. The City of Chicago is virtually all armored very effectively. North of that there's some 25 to 27 miles of glacial bluffs and north of that some 8 to 9 miles of beach ridge and dune plains, so that we get an example of what's happening all along the shore.

The Illinois shore is more of a low energy shore, rather than the Michigan side and some of the other shores. So these are probably minimal results because we have pretty good protection and very affluent communities that can do a lot of things about it.

We all know that the Chicago shore is beautiful, and not only that, it represents a state of art in shore protection. Previous generations have done wonderful things for us. Not only is it beautiful, but it's well designed, very heavy and it takes care of the worst storms that we've had.

Only once or twice have we had disasters that have come over the protection on the Chicago shore. Designs such as this have been emulated in many parts of the world with perched beaches, and yet on many parts of the shore today some 18 miles of 23 miles is parkland, supervised by a park district that does a remarkable job of protecting it.

The beaches in between are either missing, such as on 12th Street, or are depleted, like those on the south shore. They are essentially half-normal hardscrabble, and no longer really usable. And we still have the fall storms to get through so that we can look forward to additional damage. Even such famous places as Oak Street Beach are down to a greatly reduced size.

The City of Chicago stands on an old lake plain that's not far above present lake levels. In addition, as most of you know, most of it is landfill. It's very soft and needs to be protected.

Unfortunately, most of the beaches at the present time are at an elevation that should be reached by fall storms that we're anticipating. If lake levels persist through the coming spring and into fall of next year, we'll see that those are commonly inundated. This means much replenishment will be required and that many days we won't be able to get on the beaches or be able to safely walk along the shore.

Up around Loyola, for example, beaches such as this not only can be reached by the storm waves we're anticipating, but much of the areas are going to be inundated with sod interrupted and things like that. It doesn't sound too

significant on such a well protected shore, yet a single storm can do a million dollars of damage for the park district.

There's presently a shopping list for refurbishing, reconstructing and fixing parts that have been damaged. We see a $72 million need for the park district, and the big charges are yet to come. But the reason this magnificant protection that Chicago has is taking some damage now is that over the last 40 years it's been taking a lot of impact from the waves. And since about 1968 it's been high water with much overtopping. It's something that it had not previously encountered over the previous 40 years where the lake got to the levels that we're currently experiencing. Out of the last 20 years we've been at very high levels 50 percent of the time.

At the north edge of the plain, up around Wilmette and the mouth of the Chicago River, we have the south edge of the till bluffs. North from Wilmette the bluffs rise gradually, materials change, and we go to a shore that is dominated by glacial till, interbedded sand layers and silts where it rises to about 70 feet. Here it shows it at Lake Bluff over a distance of about 27 miles.

There are ten communities on that shore, where they're all affluent and where they work at managing their shore pretty well. Yet we have a lot of difficulties there. The reason we have difficulties is because of oxidized zones at the top of the bluff, and many sand layers in the upper half. There is also glacial till in the bottom that when dry has excellent engineering properties, but when wet has no support. We also have a flat table land with essentially no drainage. The rainfall precipitation goes directly into the subsurface, and when it goes down and encounters the sand layers that come to the surface. It comes out and wets the glacial till.

We also have another problem in that it's something of a free enterprise shore. Everyone who owns riparian property does his own thing at great expense. One such property has a nice walkway and gabions, at the bottom and it's going to have nothing but disaster as we know from experience.

This points out one of the problems is that, perhaps, now that we have high lake levels coming again throughout the Great Lakes Basin we should have certain standards that should be met, and that these should be provided to local, county and state governments as guides that they can follow. These standards would hopefully reduce the great amount of particulate matter that's going into the lakes and eliminate the entirely unnecessary and repetitive cost of looking after the shore.

Speaking of standards, one of the problems is standards in groins. Some of the contractors on the present shore are increasing their standards in view of these increasing lake levels. The contractor who does most of the jobs on the north shore said that he's increasing the outer elevation over present lake levels to about 18 inches in 4 feet at the inner part of the shore. Very few of the many groins that do not meet those standards cease to do their job. There's no beach and no protection and the waves have complete access to the shore.

Another innovative method is used in Lake Forest, perhaps one of our most affluent communities. When they built their groin sets, many of them now more than 30 to 50 years old, were certainly state of the art. They're orderly, done in large units that stretched for a mile or so on this shore, and are coordinated and engineered to perfection.

Even now, they are beginning to fall short. You can see overtopping where they do not have enough height. The splash aprons are not adequate, and they have slope instabilities. On our shore and on the bluff shore, erosion is insidious. The water level goes up in the slope and the people don't know it. Many of them stay off their slopes, which is a good idea. But they're very unstable and saturated.

I had the experience of jumping down in a place along the top that appeared to be perfectly solid, and went in up to the knees. And there's hardly any way, except with mature vegetation such as we have here, to guard against that unless you dewater your entire surface.

And a few people are beginning to dewater their properties in Lake Forest. But they're learning that it's experimental. I just had a call this past week from someone who had put a drywell down to 30 ft. and nothing happened. The trouble is that he needs to go down to 70 ft. to dewater the entire thing.

The contractors have been busy because forty parcels have been riprapped this year since wintertime. And they simply are falling behind, so busy in fact, that they can't take orders at the present time.

A recent survey by us, from a low-level aerial flight that we made in July, showed that 25 percent of property owners on the north shore have very serious stability troubles. The communities are doing a lot better, because the figures are only about 27 to 28 percent for them.

The federal properties we have on the Great Lakes such as Fort Sheridan are doing fairly well, except for Fort Sheridan's lower end. There's an awful lot of old jetties such as those at Wilmette that are under water. It's just a matter of time before their harbor is going to be silted in. They're going to get storm waves into the harbor and are going to sustain damage in there.

So there's going to be a lot of money put out on things like that. Once again, we're probably going to have to revise our standards. And the elevations to which these will be built are going to have to be higher. Evanston has been showing everybody the way to go. They've had a riprapping program for about the last 10 years since the last high water level, and although it's not very sightly it really does the job. They're also leading the way in putting riprap along their groins to reduce wave buildup. The reflected wave energy that comes in this way, is broken up, and though it's expensive it will greatly extend the life of their their protection.

We've just begun to look at groins as groin sets, and are also looking at their ages and at how they're constructed. And if we can carry this further, we have many things to learn that, in the long run, will save people a lot of money and grief. Their water plant is easily within high storm waves. What they'll have to do is put in some protection on the other side of the road.

From Waukegan north to Kenosha we have the Zion Beach ridge and dune plain. It's about a mile wide, and there's between 8 and 9 miles of it in Illinois. About a mile of it in Waukegan is industrialized. The famous PCB sites are there, and one of the biggest and the most expensive problems in Illinois is the Illinois Beach Nature Reserve in the Illinois Beach State Park. There's a very nice Holidome-type lodge and a large beach there, and visitation exceeds two million persons per year. The Zion Nuclear Reactor and Trident Harbor in the Wisconsin line is near an acquisition area that the Department of Conservation is developing.

The Illinois State Department of Conservation actually manages, and is charged for developing the funds for, more than 10 percent of the Illinois shore. It's a very difficult job.

Incidentally, these beach ridges, whose maximum heights are only about 10 feet above highest water, are very valuable scientifically because they represent the entire record of lake levels for Lake Michigan. They also represent the climatic records going back to the highest lake levels.

They are important scientifically, but because they are in nature preserve we're not protecting them. But we are trying to figure out some innovative way that we can retain these ridges because we have the records of the beaches and ridges that were built last year and the year before. We've identified those for the last 100 years, and as far as scientific records are concerned, it's exceedingly valuable.

The main focus at Illinois Beach has been its preservation and operation in order to bring it up to standards by Labor Day when the big crowds come. Every year it's been a battle. I was checking, and since 1973 or 1974, when we had the last very high water, they've put almost a half million cubic yards of replenishment on that beach and in the surrounding area. At the present time, even though it's in excellent condition for the moment, it still is within reach of the waves almost over its entire length.

The Department has, as a result of drastic erosion that has endangered water lines and buildings, put in a one thousand foot revetment. We've put in revetments to protect the headquarters in the northern part of that beach where previously there were a couple of thousand.

There was a $500,000 bulkhead in front of the lodge, and year after year since 1974 the State of Illinois has been feeding funds into this project as they were available. It has tested the ingenuity of our staff and has been very successful.

One of the problems we have is with the new height of lake levels over the bulkhead. It actually saved a lot the last time during the last high water lake levels. They started constructing it, and before they finished, the lake had already taken much of the parking lot. In fact, they were working in the water and it was a very near thing. At the present, wave overtopping is beginning to flood the parking lot regularly as over splash, and we're probably going to put some riprap in the front of it and perhaps kill the over splash that way. All together the Department of Conservation has put over 3,200 ft. of protection in the shore right now with 6,100 ft. left to protect.

This is to remind us of what was happening back in 1972 and 73. The State of Illinois bought those two northernmost miles, of shore from the people who lived there. It was an unfortunate development scheme that was built there when it shouldn't have been, because it's basically wet lands. It should have been preserved from the beginning, but the State of Illinois picked up the tab, demolished the houses and fixed the shore. We're back in the same mode in this same parcel of land. We've been watching recession monthly--10 ft. one month, 8 ft. the next month--in certain areas.

What's happened, is that the outer dunes that were built higher during the past 100 years had good roots and had been removed. Now the lake is taking giant steps in moving in. About 63 percent of Illinois Beach State Park is at present lake level. So you see that once the lake breeches some of the outer dunes, this is going to be true of all of those dune areas around the Great Lakes. The foundation and protection materials from houses that formerly were situated in this area gives us an idea of how rapidly it goes, and how rapidly it's being flooded. The area is essentially below lake level.

Our staff has developed a low-cost block structure and rock revetment that is being extended throughout the park. I know they haven't faced up to revetting the entire shore, but I think it's a foregone conclusion that it must be done eventually because we're losing an acre-a-year-per-mile minimum in the unexposed parts. In some cases, where we get a dune breech and overtop it and take several acres of it in one storm.

At North Point up near the Wisconsin line, it's important because this will be near the north jetty of the new 1,700 boat marina being built by the Department of Conservation. The State of Illinois is funding the marina by itself and it represents one of those hopes, one of those progressive moves for the future that Governor Thompson spoke of this morning.

Most of the engineers use elevation above low water datum when they build their structures and refer to lake levels. And of course, at the present time, we're up about 4 ft. above the water datum. We had some storms in the early part of this year where we got setups of 3 to 4 feet, with 5-foot waves coming ashore in a lot of places. A famous seiche of June 26, 1954, killed some people up at Montrose and along the shore not too far from the hotel.

Most of the groins built to these new standards are just going to function under this new regime that we have now; certainly for this fall, next spring and maybe for several years to come.

Tops of most beaches in Chicago and up and down the shores are going to be reached by the modest storms regularly, and that means a lot of sediment moved out and a lot of replenishment material that must be put back on at significant cost. And the really high storms that will top even the inner ends of the groins will be well over the top of Oak Street Beach and most of the other beaches. These storms will even be getting Lake Shore Drive in Jackson Park.

There are a couple of places that are going to be pretty wet several times this fall, and the city is going to have to build that up if conditions continue. The new harbor jetties are just about up and are out of reach of present storms pretty well. There will be some over splash, but those will be seiches; spectacular one-time events where we can't really build protection, but where we have to warn people to get out of the way.

Even with moving this protection up one foot, which is certainly within a possibility, or moving it up two feet - most of what we call our modern and best standards are just not adequate. And I think that's probably true throughout the Great Lakes.

We're probably going to look at the lakes and protection in an entirely new way after this period has been with us a while.

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collinson

EFFICIENT USE OF ILLINOIS' LAKE MICHIGAN DIVERSION

DONALD VONNAHME, P.E., DIRECTOR
DIVISION OF WATER RESOURCES
ILLINOIS DEPARTMENT OF TRANSPORTATION

I'm going to talk to you today about the Illinois diversion and the efficient use of that diversion. As the Director of the Division of Water Resources, I have the mandate to effectively allocate and manage the water that's always referred to as the Lake Michigan Diversion in Chicago.

As far as the Great Lakes Diversion in Chicago, I'm going to give you an overview of the diversions in the Great Lakes, concentrate on the Illinois diversion, and then get into the efficiency we think we use in mandating the proper use of those waters.

The most recent activity over the past two to three years, and as recent as this immediate past winter and spring, has been the execution and signature of the Great Lakes Charter. And I think ever since I've been in government -- I became a Deputy Director in 1976 -- dealing with the Great Lakes states and the provinces of Canada, these issues have been very heated at times. I think the interest, particularly in Illinois, since our diversion is one that takes water not only out of the basin but out of our state, has been one of particular concern. The Great Lakes are very very important to us all. I don't think some of these statistics have been run by you today, but this is why we as a region, the eight states and the two providences, very carefully consider what goes on in the Great Lakes and what we do with the waters in them.

Some of the more recent problems, things that we've been dealing with now, have been problems that are attributable to the higher lake levels and with a basic background in hydraulics and hydrology. With the diversions that we currently have in the Great Lakes, I consider five of them of them for lake control. For lake levels there are five essentially and the Long Lock and the Ogoki diversions actually divert water into the Great Lakes system and into Lake Superior. They formerly drained to the Albany River system and into Bay James. They bring water into the system and we take water out of the system in Chicago. The Welland Canal and New York State Barge Canal System diversions are diversions around the falls and take Lake Erie water into Lake Ontario. However, they are within the watershed within the system itself.

So essentially the only two diversions that cross basin lines are the two from Canada into Lake Superior where we take water out at Chicago. Of those, just for net differences, the Long Lock and the Ogoki diversion that are in Canada total about 5,600 cfs in over a long-term average, and our diversion at Chicago, as you've heard, is 3,200 cfs out.

Our diversion in Illinois is very important. The primary effects are to the Chicago Metropolitan area, and they were primarily done in the old days in the interest of protecting the water supply for the City of Chicago. We've

had somewhat of a good deal of history starting all the way back to the year 1900. Actually, we had a diversion out of the Great Lakes Basin before 1900. And that was done by my predecessor agency, the Illinois and Michigan Canal Commission.

In the 1820s to 1840s, they actually constructed a canal from the Illinois River in the vicinity of Morris, up along the banks of the Illinois and DesPlaines Rivers, to access the Great Lakes. But waters were actually run from Lake Michigan down through that particular canal.

The problem with the canal was that it was completed in 1848 when the railroads were making their tremendous progress here into the Midwestern United States, and rail transportation soon became more efficient than canal transportation. As a result, the canal was not used that much. But in 1900, the sanitary district reversed the flow of the Chicago River -- and I think I've been in court ever since. It's an 80-year-old law suit.

There have also been interim decrees from the U.S. Supreme Court that do affect our diversion here at Chicago. And those decrees came in 1925, 1930 and 1967. Then, finally, an amendment to the decree came in 1980. I'll talk a little bit more about the reason for that, but basically it's because of the efficient use and primarily our increases in technology and the willingness of the sanitary district to put money into increasing the degree of treatment that reduced the amount of discretionary dilution flows that we had to let pass through the system.

So as a result of our use becoming more and more efficient, the decree was modified. And in each case the total amount was reduced. As far as our diversion, we use it primarily for water supply, water quality treatment and navigation.

If you remember Nick Melas' speech from this morning, we had a situation, prior to 1900 in the Chicago area, where the Chicago Rivers--the north and south branch--flowed into Lake Michigan. And also down in our Calumet system the Grand Cal and the Little Cal met and flowed into the southern end of Lake Michigan.

The problem was that in those days we did not have sanitary treatment plants. Things were outletted directly to the surface streams, and in periods of high runoff they ran into the lake and polluted the water supply. We had tremendous medical problems -- essentially huge thyphoid epidemics here.

In order to solve that problem, this is the reversal. The additional canals that were put into the system were the Sanitary and Ship Canal and the Cal-Sag Channel. Water was let in at Wilmette and at the mouth of the Chicago River at the controlling works of the lock and dam. Water can be let in on the Calumet system with the O'Brien Lock and Dam and the controlling works there.

Again, the net effect is that the inland river system is maintained at a lower elevation than Lake Michigan, so as the controlling works are open, flow is forced into the system down and out of the basin into the Illinois

Waterway and on down the Mississippi. That is essentially what we talk about as the Chicago Diversion.

And when that diversion was made, essentially two things took place from 1900 to the present. We insured the safe dependable source of water and created a base for improved water-borne transport.

Chicago was always looked at as a hub of transportation. If we had a good canal system, the ones that were developed with the Illinois and Michigan Canal were subsequently refined by the reversal of the flow of the Chicago River. We had inland waterway access not only to the Great Lakes system, but also to the Gulf of Mexico. By traversing to the south and the west, you had access to the east and west coasts.

With the development of the St. Lawrence system, we can come up through the inland system, transit the lakes, go out the St. Lawrence and access the east coast. Navigation was also a very prime reason for doing some of the diversions and improvements in the early 1900s.

The decrees, though, that now give us the allocation that we have, stood until 1967. That's when the amounts of water that we could divert from Lake Michigan were reduced from an amount of 10,000 cfs back in the 1900s. That's what the uncontrolled rate was that was going through the system through the 1925 and 1930 revisions. In 1967 it was reduced to 3,200 cfs when my division was given the responsibility of allocating and managing that particular diversion.

We had some problems that'll come from making that allocation; however, the net result was that in 1980, as we did the studies to make our allocations to the people who had used the water, we were able to get a modification to the decree that allowed us to use that water a lot more efficiently.

This is basically how we break the water up. That 3,200 cfs falls in three categories. One is the domestic use--that's 1,900 cfs--and that's the drinking water that you use, the water for municipal and industrial purposes, and that's about 61-62 percent of the total allocation. The reserve for storm water runoff is 655 cfs. Direct diversions in the interest of lockage and leakage, navigation makeup, and discretionary dilusion for water quality purposes makes up about 18 percent.

A problem that we were having was that in 1967, when that decree was made lowering it to 3,200 cfs, all of these uses had to come out of the 3,200 cfs long-term allocation. And we were given a five-year running average to meet. A problem that we had with storm water runoff was that the parties to the suit, our sister states, were concerned with diversions in the Great Lakes prior to 1900, because at that time there was 673 square miles of land draining to Lake Michigan. When we reversed the flow of the river, it no longer drained to Lake Michigan. And the Supreme Court decree actually requires us to include in our allocation, or have charged against us, the amount of rain that would fall on that 673 square miles in any given year.

So with the five-year running average, we were always trying to guess how much it was going to rain in the year that we were in, or the next year, to

see whether or not we were reserving enough water to meet our storm water runoff allocation. If we found ourselves holding too much of that water, then we didn't have as much water to allocate for domestic and industrial purposes or for other direct diversion purposes.

The thing that we were able to do in 1980, as a result of all the more detailed studies we did to make our allocations, is that we were able to get a 40-year running average in order to balance our flows. The net result is that we're having problems.

For example, in years with high lake levels and high rainfalls, when the storm water runoff is a higher number, and when you're only working in five-year cycles when lakes have been above normal since 1969, it's very tough to get an efficient use out of a 3,200 cfs allocation, especially when you have to allocate a good chunk of your water production on a five-year running average. So the 40-year running average does allow us, we hope, to average this over periods when the lakes will return to lower levels and when we'll have lower amounts of rainfall over the basin.

The direct diversion lockage is when the two locks are opened and water goes through while we're passing traffic. We are charged for that and do calculate that. Leakage--there is leakage through the lock gates and through the various controlling structures along the lake. We also have to calculate are charged for that. Navigation makeup--as I said, the waterways in the Chicago system are commercial waterways. We do attempt to maintain them at levels of three to four feet below the level of Lake Michigan. At times when we anticipate that there is a storm moving into the area, then that system essentially doesn't have much of a gradient at all. It's a hydraulically-induced ingradient which is more effective as opposed to a profile-induced ingradient.

So what we have to do, so that we don't flood out downtown Chicago, is to blow the pool and let the water out in advance of the storm. Sometimes we miss our guess. If we dewatered the navigation system and the storm didn't come, then we have to bring it up. That's called navigation makeup, and we are also charged for that particular type use of the water.

Finally, the discretionary dilution is the water that is used to increase or to attain and dissolve the oxygen levels and other quality parameters in the waterway system. And as a result of efforts by the sanitary district, as their treatment becomes more and more effective (you heard a presentation on TARP Stage I this morning by Nick) we can now reduce the amounts of the discretionary dilusion. This is essentially what the Illinois Diversion is used for, how we've broken it up, and also some of the problems that we face as we try to allocate and manage this water.

As far as our efficient-use policy requirement, it essentially involves three areas. The first one--the adoption of water conservation ordinances and plumbing codes--primarily deals with the user of the water. The second one--water systems management--primarily deals with the owner of the system. So we're trying to provide for efficient use by dealing with the in-user and with the owner of the system, whether it's a public or private system. The

third is to continue to do what we can to reduce the amounts required for discretionary dilution in the water quality purpose.

As far as the user-oriented requirements, the big thing is that we require efficient plumbing fixtures and metering in all new construction and major remodeling in the entire service area.

At the time we made the allocation, there were 4.7 people using Lake Michigan water, and as a result of going through the allocation process, we were able to bring another 1.3 million users on line; 192 communities, four industries, and two sanitary districts. We have 198 permanentees, if you will, using Lake Michigan water. And in order to get a Lake Michigan allocation, you had to agree to this water conservation program that does require metering of new services, and also the use of water efficient fixtures that even dictates the maximum amount of water you can use when you flush the toilet or in your lavatories.

It requires close-cycle cooling for water cooled air conditioning plants and that in any new type construction these types of water saving fixtures are mandated. And if you don't agree to do that, you don't get a Lake Michigan water allocation. So the communities took this seriously.

Working on the user, we feel that we can probably reduce our water usage by about 10% in the area. But again it's something, I think, where we are the only state in the Union mandating the user water conservation techniques. Another thing that we mandate is water systems management, and this works with the owner of the system. I think we're the only state in the Union that deals with requiring the owner of the system to reduce his unaccounted-for leakage. We've gone into each of the communities where an allocation is made and determine what their unaccounted-for flows are at the end of any given year, and these are the goals that we have in the administration of our program.

The allocation was made in 1980, and these are the years and the percentages of unaccounted-for flows that we have specified that they must meet if they are going to get and keep a Lake Michigan water allocation.

The way we determine that is by calculating what their net annual pumpage is in a town. Then from their meterings, we determine their domestic, municipal and industrial use, and then estimate their fire flows by working with the American Waterworks Association and the various hydraulic and plumbing groups. We've determined that for the various cities whose distribution systems are of various ages and types of pipe, and that for a given type of pipe, type of joint, age of pipe, and age of the joint, we can determine the allowable leakage for any system.

We do this because we haven't been able to find anyone who'll even tell us that a brand new system won't leak somewhat. We then determine what the allowable leakage is for the type distribution system that a town has, subtract all of those accounted flows, and then see whether or not the town is meeting our reduction and accounted-for flow goals and principles.

When we started in 1979, we took a quick look at this, and for the 198 applicants or permitees, we had unaccounted-for flows to the tune of about 10.4 percent in our service area. In three years it had gotten down to 7.6 percent, although 1984 was the last time we checked it. So we've had about a 30 percent reduction in unaccounted-for flows in the first three and one-half years of the program. Overall it's ahead of our goal, but we have some individual communities who do not meet this or who exceed this.

We are, in 1985, five years into our allocation, and will soon take another look at the allocation use to see how people are doing. It'll take my staff about six months to run through all the 198 applicants just to see what the progress is in the use of Lake Michigan water, and to check the efficient use of our diversion.

Some newspaper people have been talking about July's high lake levels when the North Central Division of the Corps of Engineers proposed an increase in the Chicago Diversion as a possible method of reducing lake levels on the Michigan/Huron system. The proposal was coupled with work by the Canadians to reduce the inflows into Lake Superior to prevent or to help control lake levels by not allowing as much water to come in through the Long Lock and the Ogoki diversions.

The IJC also did some manipulations with the controlling works at the locks and dams at Saulte Ste. Marie to store some waters in Lake Superior. The thought was that if we could do all of these things, and we could increase the flow at Chicago from my 3,200 cfs up to 10,000 cfs, we might be able to lower the level of Lakes Michigan and Huron by about an inch if we were able to do this over a six-month period.

When this proposal was made, I did not jump and wave the flag and say this is a real neat thing to do. As the water director of the state, the things for me to decide were the following: that in Lake Michigan we're experiencing damages from high water. We have about 59 miles of shoreline and elements of two counties up there. But a problem was that the engineer and I demanded some quantification. What if we lower it an inch? What does that relate to? Can we tie that to dollars and jobs? We couldn't, and I'm enough of an engineer to realize the difficulty that the North Central Division had.

On the other end of the picture was my lower Illinois River. The Illinois River from Lockport down to the mouth at Grafton is about 290 miles, and each of those miles has a bank. That's 580 miles of shoreline I'm considering downstream. Also, I've go about 20 counties and 30 drainage districts down there.

And for the monitoring procedure that North Central Division proposed, they couldn't guarantee me that I would not incur damages in the lower basin by trying to move additional waters through the Illinois Diversion. So I didn't take the position that it couldn't be done. General Joe Pratt, his predecessor, General Jerry Hilmes and I all have engineering expertise. We have all dealt in flood control and have studied flood conditions on our rivers, lakes and streams. It's very tough when you get to the lakes to quantify dropping it an inch. What's the dollar benefit and dollar detriment

downstream? We could probably quantify it on a monetary basis. It would take a while, but it would be a little easier to do.

So when that proposal was made, I advised the Governor that I did not think it was something that the State of Illinois should propose, particularly for two reasons. First, we were the state through which the diversion was made. We might experience some damages along our 580 miles of shoreline downstream along the Illinois River, and the Corps might be able to propose a method that wouldn't do that. But as yet, I just wasn't quite satisfied.

Second, it is primarily the inability to quantify what an inch reduction up on Lake Michigan would do. So I told him that the Great Lakes Charter would class it as an increased diversion. And really, that the correct way to handle this was to put it before the consultation process that the Charter embraces and provides for, and to see if any of the other states were interested in increasing the diversion at Lake Michigan in Chicago in the interest of lowering Lakes Michigan and Huron levels.

The Governor did this. He wrote to all the Governors and Premiers who were signatories to the Charter, but we have not yet received a response from any of the other affected states or provinces showing that they would want to propose this for consideration by the consulation process. I just wanted to clarify that to you publicly here. I'm not saying it couldn't be done or that we would never support it, but from the information that I had before me, I was not comfortable in recommending it as something we should wave the flag for. And the Governor graciously followed my advice.

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QUESTIONS AND ANSWERS

WATER QUANTITY

Question: Where do Chicago and the suburbs get water for swimming pools.

Answer: DONALD VONNAHME, P.E. - Director, Division of Water Resources, Illinois Department of Transportation

Water for swimming pools all goes through the municipal system. As we went through the allocation process each town presented what its existing and projected demand was for all uses. Swimming pools were one of the things, so when we made the allocation we took into account everything that they said that they were going to use the water for. Just a note on that allocation process. In the final phase we had about six months of constant hearings and they were, by our Attorney General's recommendation, full adversary hearings meaning that if I was testifying at a town, all other 195 applicants had a chance to question me on my rationale and force me to prove my case. Also, my staff took a look at the same thing. So the swimming pool use is included in the allocation that we gave to the the respective communities.

Question: Is the per capita water consumption increasing?

Answer: My guess is that it is going down. During some interims per capita usage have been going down as a result of requiring the water conservation requirements subject to getting a Lake Michigan permit.

Question: How much is going to the western suburbs?

Answer: Out of that 19,000 in '70 that was total municipal and industrial, Chicago's two plants take up 15,000 cfs, so about 75 percent is going to the Chicago system. I think Chicago already hits a few of the western suburbs. But for the ones that don't then 25 percent of the allocation would be primarily moving west. There's some south too, but mostly to the west.

Question: How much more water will they need over the next ten years as contractors and developers create new demands?

Answer: My gut estimate would be about 500 cfs of it. My staff estimates 120 million gallons a day for the three western systems.

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GENERAL SESSION ON RESEARCH AND POLICY NEEDS FOR THE GREAT LAKES SYSTEM

DOUGLAS J. HALLETT

ENVIRONMENT CANADA -- ONTARIO REGION

Douglas J. Hallett is senior scientific advisor for Environment Canada in the Ontario Region. His primary scientific interests include toxic chemicals and ecosystems, Great Lakes and global toxicology, exposure pathways, management of hazard and risk, and engineering solutions.

Prior to joining Environment Canada, Dr. Hallett was research scientist with the Canadian Wildlife Service from 1975 to 1982. He earned his bachelor of science degree in animal physiology in 1970 from McMaster University, his master's in oncogenic virus and biochemistry from McMaster in 1972, and his Ph.D. in environmental biology and analytical chemistry in 1976 from the University of Ottawa.

His research has included the discovery and assessment of toxic chemicals found in herring gulls and fish in the Great Lakes. Highlights of his research include the confirmation of mirex in the Great Lakes, the discovery, synthesis and toxicology of photomirex, and more recently the discovery of 2,3,7,8 TCDD (dioxin) in the Great Lakes ecosystem and the development of the long-term trend monitoring of toxic chemicals in Great Lakes herring gulls. He has also done extensive research on the analysis and toxicology of crude, bunker and fuel oils.

Dr. Hallett has been chairman of the Canadian Federal Great Lakes Toxic Chemicals Committee since 1978. He oversees a budget of $1.5 million for the combined Great Lakes toxic chemicals programs of the federal departments of Environment, Fisheries and Oceans, National Health and Welfare, and Agriculture-Canada. He oversees the University of Windsor's Great Lakes Institute case study on selected toxic chemicals. In addition, he is chairman of the International Joint Commission Coordinating Committee for the Assessment of Toxic Chemicals and co-chairman of the Canada-Ontario Toxic Substances Committee.

A. ALAN HILL

COUNCIL ON ENVIRONMENTAL QUALITY

A. Alan Hill was designated chairman of the Council on Environmental Quality by President Reagan in May, 1981, and was confirmed by the Senate in July, 1981.

Prior to his appointment by the President, Mr. Hill operated his own business in San Francisco. He served for more than five years in the Reagan administration in California, first as assistant to the secretary for Resources and later as deputy secretary for Agriculture and Services.

As assistant to the secretary for Resources, Mr. Hill was responsible for resource policy development for the State of California and coordinated activities of such state entities as the departments of Conservation, Parks and Recreation, and Fish and Game, and served as Resources secretary appointee on the Tahoe Regional Planning Agency and State Air Resources Board. As deputy secretary for Agriculture and Services, Mr. Hill served in then-Governor Reagan's subcabinet group and was instrumental in formulating agricultural and land use policies for the State of California. He worked closely with the California legislature on the development, passage and implementation of the administration's policies.

Mr. Hill also served as an assistant to the minority leader of the California State Senate. In that capacity, he was responsible for research and development of legislative programs advocated by the minority party.

Mr. Hill is a graduate of the political science department of the University of the Pacific.

PETER L. WISE

U.S. ENVIRONMENTAL PROTECTION AGENCY

As director of the U.S. Environmental Protection Agency's Great Lakes National Program Office, Peter L. Wise is responsible for overseeing the United States' activities under the Binational Water Quality Agreement with Canada. The office has three major functions regarding water quality: surveillance and research, including monitoring water quality, biota, sediment and atmospheric deposition; remedial, including special studies and regulatory strategies; and environmental planning which includes nonpoint source and geographic areas of concern.

Before becoming director of the Great Lakes National Program Office, Mr. Wise was acting director of the office of analysis and evaluation in the Office of Water, U.S. EPA. In this capacity, he managed the economic and statistical analysis for the development of industrial effluent guidelines, headed the Office of Water's Clean Water Act reauthorization efforts, and evaluated the monitoring and water quality standards program.

Mr. Wise also served as acting director of the water planning division. Here, he was responsible for national implementation of the water quality management program, authorized by Sections 106, 208 and 303 of the Clean Water Act. Before becoming acting director, Mr. Wise served as deputy director of the division.

Prior to coming to the U.S. EPA, Mr. Wise was chief of water resource regulation for the Illinois Division of Water Resources.

Mr. Wise received his undergraduate degree from Oregon State University and holds a master's in regional planning from the University of Pennsylvania.

LEE BOTTS

CENTER FOR URBAN AFFAIRS AND POLICY RESEARCH

Lee Botts co-directs the newly established Environmental Policy Program at the Center for Urban Affairs and Policy Research, Northwestern University.

She became involved in Great Lakes conservation issues as a volunteer working to save the Chicago lakefront from highway development and to convert the Indiana dunes to a national park.

Ms. Botts was appointed chairman of the Great Lakes Basin Commission by President Jimmy Carter in 1978. The regional planning agency was responsible for coordinating water and related land policies for eight states and 12 federal agencies.

She previously served on advisory boards to the Ford Foundation Energy Policy Project, the Environmental Protection Agency and the Federal Energy Administration. In 1970 she organized the Lake Michigan Federation and served as executive director of the coalition of 200 citizens groups in four states until 1975.

Ms. Botts holds a bachelor's degree from Oklahoma State University.

DONALD L. TOTTEN

INTERNATIONAL JOINT COMMISSION

In July, 1981, Donald Totten was appointed by President Ronald Reagan to the International Joint Commission (IJC), a body that handles U.S.-Canadian affairs. Mr. Totten holds an IJC position on water and shoreline development. Since 1973, he has been president of a firm specializing in government relations, management and political consulting.

Mr. Totten is a 1955 engineering graduate of the University of Notre Dame. He spent 15 years in the engineering and business fields, and before being elected to the Illinois legislature in 1972, he spent 2-1/2 years as assistant to the director of the Illinois Department of Transportation.

In addition to his business and legislative experience, Mr. Totten was elected Republican committeeman of Schaumburg Township in 1966 and reelected in 1970, 1974, 1978 and 1982. He is chairman of the executive committee of the Cook County Republican Central Committee. He was state chairman of Illinois Citizens for Reagan in 1976 and a member of the steering committee of the Illinois President Ford Committee. He was regional political director for the Reagan for President Committee and was state chairman for the Reagan for President Committee in Illinois in 1980.

In the 82nd General Assembly, Mr. Totten served on the Appropriations II, Executive and Revenue committees. He is the chief sponsor of the Taxpayers' Rights Amendment, a constitutional amendment to limit state taxes, and the Illinois Enterprise Zone Act, the first of its kind to be introduced in the United States.

Mr. Totten was a founder and past national chairman of the American Legislative Exchange Council, a member of the board of directors of the Illinois Conservative Union, former vice chairman of the National Council of State Legislators, vice president of the National Tax Limitation Committee and chairman of the Illinois Tax Limitation Committee. He was the recipient of the Illinois Conservative Union's 1977 Legislator of the Year Award.

CARLOS M. FETTEROLF, JR.

GREAT LAKES FISHERY COMMISSION

Following five years in fisheries research and management with the Tennessee Game and Fish Commission, Carlos M. Fetterolf, Jr. joined the Michigan Water Resources Commission staff in 1957 with responsibility for assessing the effects of man's activities on the usability and characteristics of surface waters. On leave of absence to the National Academy of Sciences, he was scientific coordinator for *Water Quality, 1972*, a resource document for development of national water quality standards. He returned to Michigan in 1972 as chief environmental scientist for the Department of Natural Resources and accepted an appointment as executive secretary of the international Great Lakes Fishery Commission in 1975.

Mr. Fetterolf is a past president of the southern division of the American Fishery Society, the North American Benthological Society, the Michigan Association of Conservation Ecologists, and the International Association for Great Lakes Research. He recently completed 11 years on the International Joint Commission's Great Lakes Science Advisory Board and is currently president of the water quality section of the American Fishery Society.

Mr. Fetterolf holds a bachelor's degree from the University of Connecticut and a master's from Michigan State University.

GENERAL SESSION ON RESEARCH AND POLICY NEEDS FOR THE GREAT LAKES SYSTEM

DR. DOUGLAS HALLETT, SENIOR SCIENCE ADVISOR
ENVIRONMENT CANADA

The contaminants problem has leveled out and there is no longer a declining trend. The lack of a declining trend is consistent in the fish at the bottom of the slide. And we sit and we wonder why this happened, because when we had the declining trend, we thought our policies, the policies of the Environmental Contaminants Act in Canada that were taken to control PCBs were working. And why aren't they working now if they were so sound in the past? The reason is that we didn't take a quite thorough enough look in our research. And what we find today is that, in looking at the sediments very carefully, as we can through our research capability now, that there was one huge pulse of PCBs and other contaminants that went into the Niagara River at or about 1960, and the trend is more recovery from that pulse of PCBs. The depositional rate of PCBs into sediment in 1980, by 1980, is not altogether different than it was prior to 1960 in that area. So we have to look again and do a much better job at this and other problems.

What are our key problems now? Well, one of them is the air. The air in Lake Michigan is one of the key environmental sources of PCBs. PCBs are declining nicely in Lake Michigan. How much farther do we have to go in controlling this problem? Well, the key source, as I said, is the atmosphere, and if you look at 1980, what we've done here is to look at the percent reduction in terms of the loadings going into Lake Michigan, not the concentration coming out the effluence, but the actual amount of PCBs going in. When we started out with this curve, there was about 6,000 kilos of PCBs going into Lake Michigan. By 1980 it was around 2,400 kilos. When it got mean in terms of the lake trout population, I would assume they were still above the FDA guideline for consumption and commercial sale. We sought from this model how much more do we have to reduce the PCB loading into Lake Michigan to get them down to the FDA guideline of 2 ppm. It means we have to reduce the PCB loading to 750 kilos per year, which is a considerable drop we yet have to take. If we don't drop that level, what we will have, quite simply, is a leveling-out phenomena. That's exactly what we have now. Lake Superior, the most sensitive lake to persistent contaminants such as PCBs and dioxin--any of them, there's a vast number of persistent contaminants we're worried about--they're all there. And it has never really changed.

We have sources such as groundwater, which we're recognizing now from the waste disposal practices we undertook in the '50s and the '60s on both sides of the border, that are now starting their way into the system. And I would predict that they will continue to go into the system at a faster and faster rate until we correct the problem. This is a prime example on the Niagara gorge face, where it's just a good anomaly that we can look at scientifically, where we can look beneath the ground and see what happens. You can even smell them. This is the precipitation that shows you the sensitivity of the Lakes. Lake Michigan is particularly sensitive because it has a large

surface area. The larger the surface area, the more will come in; the smaller the surface area, the less will come in. Lake Superior, because of its huge surface area, is the most sensitive, and because of its long residence time, it is the most sensitive, as well. Lake Michigan has a very long residence time as well for these contaminants. The half time, a conservative half time, is around 50 years. There are other processes that will take care of contaminants once they are into the lake, but they are going to be there for a long time. Many of our contaminants, including PCBs, are in the air.

And, if you look at a balance sheet on research of what you need to know in terms of the input-output phenomena, the question marks are research priorities, and they're very, very important. The key is water-air transfer, because when we go to the balance sheet to see what sources to go after, we have to go after far more than the obvious ones, the stacks -- although they have contributed dioxin, in this case, dioxin to the levels and the depositional rates of contaminants in the sediments of the Great Lakes.

This very clearly shows you the impact of the chlorinated organic field, or petrochemical industry really, going into the lakes. But the water-air transfer is key because it links our effluence into the atmosphere of phenomena -- everything links together.

People say to me, "Dr. Hallett, I can't believe that PCBs are evaporating off the top of our lake. Surely this isn't happening." They're coming down in the rain. But have you ever thought where rain comes from? It comes from off the surface of the lake. Where do puddles go? They go up into the air. What happens? They come back down the next week, or some other time.

These contaminants, the contaminants we put into the water, the primary sink that they reach is the atmosphere. Phenomena like Niagara Falls just exacerbate the phenomena because they bubble strip them, they really move the contaminants up into the air much faster. Some of our waste treatment practices actually are designed to do exactly the same thing. One of our key policy and research areas is to look at our best available technologies and ask, "Is that technology designed to protect the ecosystem or just water? Is the contaminant just removed from the water or is it moving along into a sewage treatment plant? Is the sewage sludge being incinerated throwing that contaminant right back up into the air, or not?" We have to examine these things thoroughly and get the balance sheet together so that you can get the cost, the total cost, together.

What does this all mean, this atmospheric transfer? What counts to us in terms of contaminants? What counts to us is that we're human beings, and that we've got PCBs in us. Every mother should know that their mothers milk is contaminated with PCBs. Just as herring gulls, which I worked on for years, and coho salmon, alewives and smelts are also primarily contaminated with PCBs, DDE, mirex, photomirex, and dioxin. So are humans that live around Lake Ontario and so is the mother's milk. It's there on a North American-wide basis.

Why is this? These are all the pathways that we have to add to get to human exposure. If we analyze it to get the balance sheet of exposure, what we find is that the air and the transfer of contaminants from the air into our food is our key human exposure route. So we're not worried about contaminating the Great Lakes in terms of adulterating a fishery, or worried only in terms of adulterating drinking water. We're worried about it very selfishly because we're adulterating ourselves. We are part of the ecosystem.

And I think once we realize this, we realize that mother nature is a lot closer to us than we ever thought and that our policies, perhaps, will become a little closer to home as well.

These are PCBs in North American food. It's all documented in the literature; it has been for years. There is our dietary intake, our key intake. But again, it's quantitative. It's not the concentration that counts, but it's our loading that counts. It's plant food because we eat so much of it.

Plant food is our key source of dioxin into our body. But it comes from the environment, it comes from those effluences, it comes from those emissions. We are part of the ecosystem.

What effect will this have? We don't know. It's very hard to find a control population, though, because this is a North American-wide phenomena. But the smoking statistics show us that if we're going to have an effect on a population-wide basis that we can see, there will be a lag phase. The big pulse of dioxin, of PCBs, of many of the contaminants into the lakes was about 1960. We're now 25 years later. And there was about a 20-year lag phase in the cancer rate for smoking. However, smokers can be identified. This is a general phenomena in North America. If we take the steps, if we form the thorough policies to remove the contaminants at source, then mother nature, fortunately, will take of a lot of the rest, because ecosystems are very resilient, and they have mechanisms to repair themselves. What we have to watch out for is that the ecosystem not surprise us and crash on us, and remember as well that we are part of that ecosystem.

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ILLINOIS' GREAT LAKE:
PROTECTING AND DEVELOPING A VALUABLE NATURAL RESOURCE

HONORABLE A. ALAN HILL, CHAIRMAN
COUNCIL ON ENVIRONMENTAL QUALITY
EXECUTIVE OFFICE OF THE PRESIDENT

When Governor Thompson invited me to participate in this conference, he stressed the importance of consideration of a wider perspective on the complex issues involved in making responsible decisions on the future of the earth's greatest fresh water system.

The Great Lakes are truly a most valuable natural resource. That the theme of this Conference covers the topics of protection and development may seem contradictory at first glance. Those who are involved in conservation issues, though, realize these two activities must work in harmony.

Protection of a resource provides a means to guide its use. Such informed guidance will encourage wise development, which in turn provides the income that funds protection activities. Both must proceed in balanced manner, and I'd like to commend Governor Thompson for his interest in both development and protection.

I'd like to take the next few minutes to share some thoughts about the topic of environmental data and monitoring. This topic forms the basis for future decisions regarding protection and development. We at the Council on Environmental Quality have given the subject considerable thought.

Last fall and winter, CEQ convened a set of four, two-day meetings of experts to focus on the need for long-term environmental research and development. We issued our final report on March 18, 1985. Basically, the panels focused on specific research areas. Those are: human health impacts and their mitigations; geochemical and hydrologic processes and their protection; environmental impacts and their mitigation; and finally, monitoring assessment, and environmental management.

Our project was a cooperative effort of EPA, the National Science Foundation, the Department of Energy, the National Institute of Environmental Health Sciences and the Nuclear Regulatory Commission. Copies of the report are available through CEQ.

While many of the recommendations go to issues well beyond those concerned with water quality and quantity, there are many that will bear directly on the subject of this conference.

One underlying theme of this conference is "information" -- information developed through research monitoring and the contribution and maintenance of accurate data bases. I am reminded of a story which appeared in the Chicago Tribune.

Abraham Lincoln was vastly disturbed during the Civil War because he was so often denounced and critized by people who pretended to be wise on a minimum diet of facts and information. They offered wisdom they did not possess. So whimsically he told the story of a backwoods traveler lost in a terrific thunderstorm.

The rider floundered thru the mud until his horse gave out. Then he stood alone in the middle of the road while lightning streaked and thunder roared around him. One crash seemed to shake the earth underneath, and it brought the traveler to his knees.

He was not a praying man but he made a petition short and to the point: "O Lord, if it is all the same to you, give us a little more light and a little less noise."

The point is, we cannot give light or wisdom we do not have, and we do more damage than good when we speak with authority from a vacuum of knowledge and information.

In order to remove that vacuum, we need to begin at the beginning - and that is with research - research which spans as great an amount of time and covers as many critical areas of concern to be useful and effective. We need to look at the long-term.

Long-term environmental R&D includes three kinds of activities: (1) anticipatory research, designed to identify potential environmental problems before they occur; (2) investigations of a continuing nature, such as ecological baseline studies that may require a period of up to several decades to complete; and (3) fundamental research, the output of which may advance basic understanding of environment-related processes.

Scientists knowledgeable about health and the environment recognize that man-made pressures placed upon natural resources, both living and nonliving, are more severe than previously suspected.

During the past 40 years a wide variety of new synthetic chemicals have been introduced, some of which appear to pose serious acute and chronic health effects. Of similar concern is evidence of potential damage to such important natural processes or properties as biogeochemical cycling or biologic diversity.

Ignorance about many scientific questions has resulted in acknowledged problems of environmental management, such as inappropriate regulation in the face of data uncertainties or heightened public anxieties. Long-term environmental and health research is needed to resolve scientific uncertainties, to establish baseline health and environmental parameters, to overcome lack of understanding of the short-term variations in natural systems, and to identify long-term trends and relate them to their causes.

For a variety of reasons, current incentives for private sector and governmental support of environmental and health R&D favor short-term approaches. Government agency research programs are generally designed to support mission

goals of the agencies sponsoring them, resulting in relatively short-term research planning horizons that do not extend beyond immediate regulatory or programmatic requirements. Similarly, corporate research efforts frequently support near-term product development strategies, and are necessarily reflective of annual (or shorter) profit and loss statements. Current government and public concern over such environmental problems as acid deposition phenomena illustrates the fallacy in continued reliance on short-term research design. Although the potential environmental and health effects of acid particulates were pointed out years ago, relatively little research attention was devoted to following up on early studies noting these effects, and the commitment of resources could not be justified on the basis of then-current regulatory strategies. Accordingly, long-term acid deposition research programs were deferred; had they been undertaken a decade ago, they might by now have been yielding information and predictive models of use to current regulators and policymakers.

We believe there is need for a greater resource commitement to better direction, coordination, and interdisciplinary integration of long-term environmental and health R&D. Improvements in environmental management will flow from better characterization of environmental phenomena, increased understanding of basic mechanisms, and the development of more meaningful measures of hazard or harm assessment. There clearly is a need for good long-term monitoring data and accompanying quality assurance to evaluate models used for understanding processes and environmental trends. Lack of validated monitoring time series data, based upon even crude health and environmental measures, has impeded the expansion of fundamental research programs.

In addition, modeling can be an integrating force for the environmental research community, in that the imposition of modeling requirements yields helpful insights in identifying needs and opportunities for new research. However, the use of models must be accompanied by continuing efforts to validate them.

Only with research continuing over many years, and for projects that extend over a substantial period of time, those focused on fundamental issues, will the nation be able to develop the credible and necessary expertise to better rationalize environmental management policies. Environmental science needs a critical mass of talent and resources to effectively approach the challenge of understanding complex environmental and health phenomena.

One of the recommendations made by the panelists is of primary concern to you. It concerns data monitoring, collection and analysis.

Monitoring yields essential current and time series information on the status of environmental systems. Thus information is used both for environmental management and for regulatory compliance. The panelists believed that the lack of coordinated scientific procedures account for such problems as nonstandardization of monitoring practices and for failure to monitor the parameters of greatest importance or relevance.

In spite of significant efforts expended on the collection of environmental data by a variety of unrelated and uncoordinated state and Federal agencies, no adequate system exists for the integrated collection, storage, maintenance, and quality control of such data. It was recommended that CEQ foster an evaluation by an appropriate organization of existing physical, chemical, and biological monitoring programs (an extant data associated with them) to identify and stimulate research and development on improving the quality and cost-effectiveness of monitoring programs. Particular emphasis should be placed on determining requirements for biological and environmental monitoring, on identifying pollutants such as toxic chemicals for sampling, and on determining information and statistical requirements for environmental models.

In this regard, the Council has addressed the idea of an Interagency Initiative on Environmental Monitoring and Data. There are several compelling reasons to revisit the environmental monitoring issue from a comprehensive, multi-agency perspective. You are all concerned with the collection and sharing of data and the need for better ways to accomplish your given tasks. Recent studies point to the continued need for improvement in the monitoring of environmental trends, and in the more effective dissemination of information on environmental quality to all concerned organizations and individuals.

In addition, there is clear congressional interest within the last two years pointing to the need for resolution of monitoring problems, and proposing a national environmental monitoring commission to do what the agencies themselves could be doing. The increasing budgetary austerity that most agencies will face argues for the use of common methods, cooperation in monitoring common parameters, standardization of methods, and the pooling of data.

Because of its location within the Executive Office of the President and the Council's responsibilities relative to environmental information, CEQ can effectively serve as the catalyst to encourage multi-agency cooperation in this area. We propose to establish a core group within the Council on Environmental Quality and an oversight committee composed of representatives from Federal agencies to update and publish a report on Environmental Trends in the nation; identify an aggregate set of key environmental indicators capable of assessing the environmental health of the nation; and for each indicator proposed, recommend an approach for collecting and aggregating data, under which measurements can be regularly and cost-effectively obtained.

We in this room today well realize that comprehensive environmental management approaches depend upon the availability of reliable theories, data, and expert opinion. Advances in environmental sensors, information processing, transfer of scientific and technical knowledge, and use of environmental data bases can increase our ability to effectively manage our environment.

Basic scientific research and monitoring and assessment activities, provide useful but voluminous amounts of information that must be evaluated to assure its reliability in identifying, resolving or mitigating environmental problems. However, in identifying long-term research and development needs, it is important to first distinguish between research and monitoring; that is,

between studies that attempt to improve our understanding of how environmental systems work and studies that provide data on the status of those systems. Our basic understanding must guide the choice of what parameters to monitor, and to answer questions of research priorities and quality control.

In order to improve methods of data analysis and interpretation, a number of additional questions must be answered. For example, how are the large environmental data sets, currently maintained by the federal regulatory and management agencies, being used? Are they used in state-of-the-art models and analyses that are clearly related to human health and environmental quality do they reflect our knowledge of how systems work? Are they ever used to improve our basic understanding of how systems work? How many people outside the agencies use the data? What are the problems and impediments in using and interpreting the data? Has basic knowledge about the working of the systems being sampled been used to increase the efficiency of sampling and the utility of the data in detecting trends?

Through your efforts in the development of environmental information resources, you can help evlauate the cost-effectiveness of previously implemented programs, while identifying where additional efforts are needed, thereby determining where funds need to be allocated. You are able to assist in the promotion of new programs by substantiating the effectiveness of other similar programs and by justifying budget requests for these programs.

While these and other recommendations from our meetings are most general, I'd like to suggest that they do offer some thought on national needs as developed by representatives of major parts of our society. I hope they will be of some use, as you consider the regional issue of Illinois' Great Lake: Lake Michigan.

I'd like to conclude by offering my personal congratulations and good wishes for your consideration of the serious issues before this conference. Your topic is important, and deserves serious attention.

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EPA'S VIEW OF THE RESEARCH AND POLICY NEEDS FOR THE GREAT LAKES

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GREAT LAKES NATIONAL PROGRAM OFFICE,
U.S. ENVIRONMENTAL PROTECTION AGENCY

One must think about research needs as the questions that managers need to answer in order to successfully carry out their mandates in the Great Lakes. When I think about policy needs, I think about the political world and the ability to get things done. Today I would like to discuss both of these issues briefly.

The articulation of the goals of a program designed to protect the Great Lakes is an important place to start. One goal should be a healthy ecosystem and a healthy Great Lakes environment. This can be subdivided into two categories. First, the health of the biota, the fish and other creatures that are in the water. It also includes the birds and mammals that rely on the fish as part of their diet. When research needs are asserted, we must think about the questions we need to answer to better protect the health of the biota of the system. The second major goal is human health, the use of the Great Lakes system by the population that surrounds it. We are concerned with drinking the water, eating the fish and swimming in the water.

What are the questions that we need to answer to make sure that the aquatic ecosystem is healthy? EPA and the States have spent over $6 billion in building and upgrading sewage treatment plants. We made this investment because lake eutrophication in Lakes Erie and Ontario was having a significant adverse impact on the health of the biota. It has been estimated that 80 percent of the floor of Lake Erie was biologically dead in the early 1970s. Our goal, based on models, was to reduce phosphorus input to the Lakes. We can document that phosphorus loadings have been significantly reduced. The research question is what difference has this reduction meant to the aquatic life. We measure phosphorus through chemistry and do that routinely. However, the question we needed to answer was how has the biota responded to our experiment to remove phosphorus from the Great Lakes proper? We need to undertake more biological work at all levels within the food chain to see how the system is reacting. Some scientists have said, for example, that we did not focus on the right chemical. Others worry that we may be starving the system of phosphorus, a nutrient that it needs.

Another major research question relates to the balance of species in the system. The system has been significantly altered with exotic fish species. For years, we have been introducing to the system, both accidently and with a purpose, such exotic species as alewives and salmon. Can we get the system back in balance so that we do not have to continually be reacting to the failure or the overabundance of a given species? There are scientists that have indicated that the reason that the plankton population is reacting the way it is, is not because we reduced the phosphorus load, but rather because of the change in the balance among various fish species in the lakes. If we

are to protect the health of the biota in the lakes, we need to understand the relationship between the chemistry, how the biology is reacting to the chemical make-up of the lakes, and how the various species are reacting to one another.

Another question related to the biota of the system is habitat. Certain species in the Great Lakes - for example, lake trout - are not naturally reproducing. Is this caused by the lack of habitat or is it due to toxic chemical pollution? Have we destroyed the fragile habitat to the point that we will always have to operate a "put and take" fishery, using hatcheries, or can we stimulate the trout and salmon to reproduce naturally?

A final issue related to habitat health is that of sublethal effects on the fish in the Great Lakes. Cancerous tumors have been found on fish in the Black River, a tributary to Lake Erie, and in other locations in the Great Lakes. What is causing it, and what needs to be done to correct the situation?

I have listed questions that I believe we need to answer to in order to fully direct our management programs to meet the goal of a healthy biota in the Great Lakes system. Next, I will have questions about how the system affects human beings who live in the basin, and what scientific questions need to be addressed to assure their safety.

What is safe in terms of humans? That is the ultimate question. For the first time, we now set standard fish advisories for all of Lake Michigan. Before, each of the four Lake Michigan States had different advisories for fish. We have devised standard chemical protocols for measuring and interpreting levels of contaminants in fish so that some of the confusion that previously existed among laboratories has been alleviated. But that's just the first step. We want to be able to tell people what is safe in terms of fish consumption. I don't think we now can do that. For example, the FDA limits right now for aldrin and DDT are not based on risk assessment. They are not based on scientific data that shows if you eat a certain amount of fish it will be safe. Although their origin cannot be accurately documented, it is believed that these limits regulating commercial fishing in the Great Lakes are based on the analytical detection limits of the early 1970's. We need better risk assessment so we can inform people what it means for them to consume Great Lakes fish. We have labels on cigarette packs that say, "This activity is hazardous to your health." We also have fish advisories, but these fish advisories are not based on the best scientific data available to us. They do not truly give a clear picture to fishermen as to what is safe.

We need epidemiological studies that are very costly and very time consuming, yet essential. When we now assert a health risk, we are basing it on research on rates or other mammals and projecting those results to humans. It is difficult to convincingly demonstrate direct human effects for many of the chemicals we regulate in the Great Lakes. For some chemicals, such as PCBs, we need epidemiological work. When the Outboard Marine Corporation testified during the Waukegan Harbor case, they asserted that EPA could not prove that PCBs are harmful. We can prove that the chemical bioacculumates

in fish from the sediment; that humans who eat greater amounts of PCB-burdened fish have greater amounts of PCBs in their body; and we can demonstrate that PCBs do get into mothers' milk. What we have not completed is long-term epidemiological work that shows sublethal impacts to humans. I believe this should be done. It should be noted that in the Waukegan situation, EPA recently lost a legal suit. The issues debated in that suit had to do with access to Outboard Marine's property for the design of a PCB disposal facility. It is important to note that the decision did not deal with the toxicity of PCBs.

The questions of understanding the health of the system, the biota and human beings are challenging. We must get a better handle on these issues. But we cannot wait; obviously, we have to act. We must regulate in situations of obvious toxicity or other system abuse. We must eliminate chemicals from the Great Lakes system that have been proven to be acutely or chronically toxic to the biota.

The pathways of toxic chemicals to the Great Lakes vary. No longer can EPA rely solely on the Clean Water Act, which regulates point sources discharges. Allow me to review several pathways of pollution to the Great Lakes. I will highlight what we know and don't know about these pathways, and identify the research needed to quantify these sources.

The most controllable pathway of pollution to the Great Lakes are point sources. We have accomplished major pollution control through point sources, yet real questions about the complex mixtures of toxic chemicals remain. More work is needed on the standardization of biological testing for determining chronic toxicity. We need to understand what happens to these chemicals when they are removed from one media and released into another.

We are focusing efforts on taking certian chemicals out of the water, but we may incinerate them and release them back into air and ultimately into the lakes. This inter-media interface needs to be better understood.

The toxic focus of nonpoint sources is pesticides. What percentage of these chemicals used in the Great Lakes Basin are reaching the waters in the Great Lakes? The Great Lakes National Program Office recently sponsored studies conducted by Heidelburg College in the Lake Erie Basin which found that atrazine, a pesticide licensed by EPA, is in fact showing up in potentially significant quantities in the water supply systems of some Ohio communities. Evidently, atrazine is much more persistent than originally thought. Based on these monitoring data, the Office of Pesticides Program is now re-examining this chemical. We need much more, both in terms of research and understanding, of what chemicals get into the Great Lakes system via agricultural runoff.

Perhaps the least quantified source of toxic chemicals to the Great Lakes is that coming from the atmosphere. I do not believe we have the sampling and analytical methods to make defensible statements about what is coming in and what is leaving the system via the atmospheric medium. Canada goes about their analytical procedures one way, we do it a different way; thus, our data

are not comparable. This is the pathway for which I think we have the farthest to go, and maybe it is the hardest to deal with and control. In addition, it could be the most significant of all.

We have documented in the Niagara Frontier and in the Lake Calumet area how toxic chemicals are reaching the Great Lakes through groundwater as a route. It is not known to what extent this problem is significant and exists throughout the Basin.

In-place polluted sediments continue to be a significant issue, primarily in river mouths and harbors. These sediments are both a sink for toxic chemicals and a source of toxic chemicals to the biota. Another issue is, what is clean? For example, the Superfund Program has designed a cleanup in the Waukegan Harbor to 50 ppm of PCBs at an estimated cost of $21 million. After this expenditure, it is unclear that this will have alleviated the problem of bioacculumation in fish. We need to develop tests, scientific tests, that will allow us to determine to what level we should cleanup polluted sediments, to demonstrate that our cleanup has been successful, and that toxic chemicals are no longer bioacculumating in the food chain to levels of concern.

As you can see, there are a multitude of sources and pathways of toxic chemicals to the Great Lakes. We need to get a better understanding and quantify these sources, so that we can develop the necessary regulatory programs to protect the system.

I spoke earlier about the need for political will. For instance, a number of areas of heavily contaminated sediments have been found throughout the Great Lakes area. We call them "areas of concern". These areas of concern have been known for years. The International Joint Commission (IJC) has had such a list for 10 years, even 15 years, and maybe one of them has been recommended to come off the list this year for the first time. The IJC came up with a new classification system to try to encourage States and provinces to get moving in these areas and to deal with these problems. Basically, a system says: (1) you either don't know what your problem is, or (2) you're trying to find out, or (3) you've got a plan to remove it, or (4) you've basically cleaned it up.

There are 10 areas of concern in Lake Michigan in different stages in terms of cleanup, but what we really need to do in this particular area is have the political will to move. We must get in and develop the plans, then actually get the legislation passed to secure the funds to take care of the problem. Those are some of the questions that I'd like to answer in order to do our job better.

A related management problem is funding. The Five-Year Strategy of the Great Lakes Program Office at EPA explains all about those pathways by which toxic chemicals enter the Great Lakes, and what we hope to accomplish between now and 1990. A lot will depend on what resources we have. For instance, Sections 106, 205(j) and 205(g) of the Clean Water Act, make Federal funds available to States for water quality control. They have basically for the

last several years been flat, even dollar quantities. Our programs of research and development have been up and down, and we've survived at the whim of Congress. When the Agency has requested one amount of funds, Congress has generally added funds to it. Thankfully, this year, we didn't have to go through that. Beyond that, Region V has added resources on top to allow us to do the job we think we have to do. Keep something in mind about funding in the Great Lakes, when we talk about even or flat funding. The number one problem is the inflation rate.

If you look at our programs starting in 1977 and 1978, and figure where we are now, it's actually only a percent of the resources that we started with in 1977 when we were formed. The other programs, the Sea Grant and the Great Lakes Environmental Research Laboratory of the National Oceanic and Atmospheric Administration, have essentially been constant as well.

In summary, we have a lot of questions. I think the Water Quality Board and EPA have tried to put a structure around ways to answer these questions. The first question asked is, "Do you have money to do the job?" I have to answer this way, working for EPA: "If the Great Lakes amendment passes, which is currently before the House and Senate, and amendments to the Clean Water Act that deal with the Great Lakes are fully funded, that would double our Office's budget." Do we have enough money? I can say that we have plenty of positive things to do with new money, if we get it.

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AREAS OF CONCERN IN THE GREAT LAKES BASIN
NIPIGON BAY
JACKFISH BAY
PENINSULA HBR.
THUNDER BAY
LAKE SUPERIOR
CANADA
USA
ST LOUIS R.
TORCH L.
DEER L.
ST. MARYS R.
SPANISH R.
MANISTIQUE R
MENOMINEE R.
FOX RIVER AND SOUTHERN GREEN BAY
SHEBOYGAN
MILWAUKEE ESTUARY
WAUKEGAN HARBOR
LAKE MICHIGAN
WHITE L., MONTAGUE
MUSKEGON L.
KALAMAZOO R.
GRAND CALUMET RIVER AND INDIANA HARBOR SHIP CANAL
LAKE HURON
SAGINAW RIVER SYSTEM AND SAGINAW BAY
PENETANG BAY TO STURGEON BAY
COLLINGWOOD HBR.
ST. LAWRENCE R.
BAY OF QUINTE
PORT HOPE
TORONTO
LAKE ONTARIO
OSWEGO R.
ROCHESTER
HAMILTON HARBOUR
EIGHTEEN MI. CR.
NIAGARA R.
BUFFALO R.
ST. CLAIR R.
WHEATLEY
CLINTON R.
DETROIT R.
ROUGE R.
RAISIN R.
MAUMEE R.
LAKE ERIE
ASHTABULA RIVER
CUYAHOGA RIVER
BLACK R.

PAST PROBLEMS AND FUTURE PROSPECTS

LEE BOTTS
DIRECTOR, GREAT LAKES PROJECT
NORTHWESTERN UNIVERSITY

My subject concerns the past problems and future prospects for the Great Lakes. I'm going to try to tie together what you have heard discussed today about the Great Lakes in the context of our continuing problems in Washington.

I represent the drinkers' lobby. This lobby is concerned about the future useability of the Great Lakes as a drinking water source. One of the themes today is the need to prevent contamination, as well as to clean up what has been left over from the past.

The Great Lakes experience has demonstrated what can be done to solve environmental problems across an international border. If we learn how to solve the problems that still exist for the Great Lakes, the Great Lakes ecosystem can continue to serve as an environmental laboratory for the world, as it already has in the past. But we don't seem to be able to get appreciation for the importance of the Great Lakes in Washington.

Consequently, we continually face and have been facing for many years a struggle with Congress. For 10 years we have continually had to lobby Congress to keep budgets at manageable levels, to try to restore programs. We have been partially successful. Here is what is happening currently.

Most of us realize that addressing the Great Lakes as an ecological problem began back in the last century when we first realized that what Pasteur told us about the connection between human waste and disease was very true in Chicago. The 19th Century engineering solution was to send the problem to Peoria and St. Louis. In 1909 we took another step by entering into a treaty with Canada. The Boundary Waters Treaty signed by the two countries set up a system to resolve any questions about levels and flows, but also recognized water quality as a possible issue for the future. Well, it was an issue right away.

There was a big report by the International Joint Commission in the teens of this century about the deteriorating water quality in the Great Lakes, but it was perceived then as a local problem and no actions were taken. Beginning in the 19th century and continuing in the 20th century up to the present many exotic species fish entered into and caused fundamental changes in the Great Lakes ecosystem. Some of those introductions were deliberate and some were accidental. In 1955 the binational Great Lakes Fisheries Commission was established to address the problem of control of the the sea lamprey, one of the undesirable species that had entered the Great Lakes to cause substantial devastation.

We're still not sure about the relationship between water quality habitat changes and the introduction of those fish. We do know that the stability of the ecosystem requires that we understand the relationship between water quality and fish. By the 1960s we had become concerned about productivity, or what the scientist called eutrophication. The information the scientists provided about changes that were occurring, most obviously in Lake Erie and soon becoming obvious in Lake Michigan and elsewhere in the system, led to a new international agreement. The Great Lakes Water Quality Agreement between Canada and the United States provided that each country would try to achieve specific water quality objectives under its own national laws.

The agreement does not say Canada has to do things our way and we don't have to do things their way. Both sides agreed to reduce phosphorous loadings to the lakes because the scientists agreed that phosphorus was the limiting nutrient. That was the most important thing that we thought we needed to do at that time. Second, the agreement provides a system of accountability by requiring cooperative monitoring through the International Joint Commission. Under the agreement the two countries have monitored what has been happening in the Great Lakes and, as you have heard over and over again today, our knowledge is incomplete. Still, we know much more than we did before.

The agreement also provided that each country would carry out its own Great Lakes research as well as cooperative research. One of the most unusual features of the agreement is that it recognizes that new problems would emerge and provides a process to address them. Finally, it also provided that, because new problems are likely to occur, periodically the agreement will be reviewed and that the objectives might have to be changed.

Under the first agreement signed in 1972, we made a huge step towards reducing phosphorous loadings. Scientists tell me that there is no place else in the world where two countries across an international boundary have achieved what we have achieved in the Great Lakes region by a variety of efforts. Our states adopted a phosphate detergent ban. We built a bigger and better sewage treatment system. We carried out a huge cooperative research project to find out how much phosphorus was getting into the Lakes from land runoff.

In the Pollution from Land Use Activities study, atmospheric deposition was identified as a major source of pollution into the lakes. By 1975 PCBs were found in fish on Isle Royale in Lake Superior, and we realized that the PCBs could have only gotten there through the air. Earlier hearings in Wisconsin had demonstrated the role of DDT in the food chain in Lake Michigan, causing the Great Lakes states to ban DDT several years before the national ban on DDT was adopted. PCBs were found in the fish in Lake Michigan in monitoring for what happened with DDT.

It was recognized right away that PCBs would be a bigger problem than DDT because of the chemical structure that made them persistent in the environment. The presence of PCBs and their ubiquity led ultimately to the 1976 ban on most uses and manufacture of PCBs in the Toxic Substances Control Act.

Before the ban we had gone through a process in which Washington said, well, it's just a Lake Michigan problem. Then they said, well, it's just a Great Lakes problem. Then PCBs were found in the Hudson River and elsewhere. We now know, and need to stress to politicians who translate policies into law, that if an environmental problem is a Great Lakes problem, we have to assume it is a global problem. Indeed, the toxic contamination that we are struggling with in the Great Lakes has to be assumed to be a global problem.

When the first Great Lakes water quality was reviewed and a new agreement negotiated, the second agreement signed in 1978 had a new emphasis. The new agreement emphasized control of toxic contamination of the system. It also calls for an ecosystem approach to management because by that time we were already aware that the toxic contaminants did not enter the Lakes only from the ends of pipes.

They enter through the air. We now know they are being released from the sediments. We also know that they are re-entering the air from the lakes, possibly after having been deposited from the atmosphere in the first place. Now it is time to review the Great Lakes Water Quality Agreement again. It is time to set new objectives that will let us move further in achieving the ecosystem approach to management that was the other major new emphasis in the 1978 agreement.

Orie Loucks said this morning that the National Academy of Scientists and the Royal Academy of Canada have concluded a review of progress under the 1978 agreement. The results will be reported by the end of 1985. The next step will be for the governments to begin to review the agreement.

One of the brilliant things about the agreement, and perhaps one of the reasons it has worked, is that it recognizes that national governments want to do things their own way. But we have a problem in the United States because the need to fulfill our obligation under the agreement is not written into the Clean Water Act. The Environmental Protection Agency operates under legislative mandates. It organizes itself and its activities in terms of the individual laws. But sitting out there at the side is the Great Lakes program.

I believe that one reason the Great Lakes program has had so much instability in its funding and the reason why it has been necessary to lobby every year in Congress to maintain a Great Lakes commitment is that there has not been a legislative mandate in the Clean Water Act. The Great Lakes amendment proposed in a new Clean Water Act is to give a legislative mandate to EPA in the Clean Water Act to fulfill our obligation under the Great Lakes agreement.

There is something else we need to do in the Clean Water Act which will be coming up soon for reauthorization in the Congress. We need to make certain that we have enough funding to continue providing adequate sewage treatment systems in order to finish the job of reducing phosphorous levels in the Great Lakes. Earlier this year in consideration of a new Clean Water Act there was an effort to allocate sewage treatment funding on a formula that cut what the Great Lakes region would get by 90 percent. It required a

concerted effort by members of Congress from the region to put back a part of what we need. But we have to make certain that we get even that much when the Clean Water Act is finally acted on in Congress.

What I would really like to have, of course, is a Great Lakes ecosystem protection act. Lacking that, we have to get the job done law by law. I would like to mention a couple of other pending policy decisions, which I put that way because this session is supposed to be about policy. One has to do with the Clean Air Act. You have heard today how low levels of toxic contaminants bioaccumulate and bioconcentrate in the Great Lakes food chain. The Clean Air Act does not do a thing about that problem because it says you have to breathe something and drop dead before toxic contaminants in the air are a problem. That's not the way it happens in the Great Lakes.

We know that PCBs and many other toxic contaminants are accumulating in the bodies of the people who live in the Great Lakes region, but we do not presently have a regulatory program or an environmental law that addresses that process of bioaccumulation. We need to amend the Clean Air Act to address this problem.

I want to mention the Resource Conservation and Recovery Act because we need to give it much more attention. Notwithstanding the fact that resource recovery is in the name of the act, most of the emphasis has been on cleanup, since the act has not been implemented. I am not knocking cleanup, but for the long term this region - more than any other region of the country except maybe New Jersey - has to emphasize reducing the amount of wastes created in the first place so that we don't face cleanup in the future.

One of the problems we have in the Great Lakes is that we talk so much about PCBs. The truth is that we know that there are hundreds of chemicals and metals accumulating in the Great Lakes system and there is no way we are ever going to be able to solve the problem one chemical at a time. And the answer is not clean up after it happens, but preventing contamination.

The Superfund law is also up in Congress. Before the Waukegan decision on access this week, we thought we had to keep the law in force to get funding to proceed with the cleanup. I am worried that the court decision may set a precedent with national significance. When a coalition of Great Lakes lobbyists and envionmentalists goes to Washington next week to tell Congress about our concerns, we are going to have to raise the issue that this decision says nothing about how to solve the problem of the PCBs. All the decision said was that, if the Outboard Marine Company does not want to let EPA onto its property, EPA does not have the right to go on the property because EPA has not demonstrated existence of an emergency. This brings us back to the old idea that there has to be an immediate effect before any action can be taken to stop environmental damages.

In summary, we need to raise the question of preventing future contamination and/or continued deterioration. We also need to get Superfund reauthorized so that we can proceed with the cleanup. It is time again to review the

Great Lakes water quality agreement. And I'd like to conclude by mentioning some of the things that I think the next Great Lakes water quality agreement has to address.

One, of course, is that we have to build on what we have learned from our experience to date. The states and the provinces have recently entered into a voluntary water management agreement known as the Great Lakes Charter. The first time the water quality agreement was negotiated and the second time as well, the states were not really included in the process because the Constitution says that only the Federal government can engage in foreign relations and foreign policy matters. However because we do have to deal with the Great Lakes as an integrated ecosystem, the provinces and the states have to be partners in the development of the next Great Lakes water quality agreement. We have to make sure that U.S. agencies have the funding to hold up our side of the agreement and continue to get the benefit of this international partnership.

The ultimate objective of the Great Lakes water quality agreement - to maintain the ecological integrity of the system - has to be stated even more firmly. No one mentioned today that the first principle of the Great Lakes Charter is maintenance of the ecological integrity of the Great Lakes. Only by strengthening the water quality agrement, only by continuing to try to translate what we have learned from the monitoring and the research and the experience of the Great Lakes into laws, and only by continuing to carry our message to Washington can we achieve this objective. We have to yell and scream louder and harder though, and I hope you are not all going to leave it up to the handful of us who are going next week to lobby for the Great Lakes.

Only when we have achieved an ecosystem approach to management will we be able to accomplish what we really need to do in this region. That is to figure out how we can carry on our economic activities, while maintaining the Great Lakes ecosystem's capacity to renew itself. If anyone would like information or if there is anyone who is inspired to join us in our trip to Washington next week, several people who are planning to go will be glad to give you information and you are invited.

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CURRENT ENVIRONMENTAL RESEARCH NEEDS TO SUPPORT THE GREAT LAKES WATER QUALITY AGREEMENT

DONALD L. TOTTEN
MEMBER, INTERNATIONAL JOINT COMMISSION

I have been asked to give a Commission perspective on research needs to support the Great Lakes Water Quality Agreement. As you may have known, the Commission commented briefly on the subject in its two biennial reports. I shall refer to suggestions in those reports as well as mention areas which are being discussed for inclusion in the forthcoming third biennial report.

Article VII (f) of the Great Lakes Water Quality Agreement of 1978 gives to the Commission responsibility for the "... provision of assistance in and advice on matters related to research in the Great Lakes Basin Ecosystem, including identification of objectives for research activities, tendering of advice and recommendations concerning research to the Parties and to the State and Provincial Governments, and dissemination of information concerning research to interested persons and agencies." The research includes suggestions by the Great Lakes Science Advisory Board and the Commission. Before discussing specific research, there are a few comments about the management of research that the Commission believes is important.

Major government and private institutions in the United States and Canada carry out research related to the Agreement. Too often, research designated specifically to support the Agreement has a short time frame for completion and application. Due to fiscal year restraints, long-term projects essential in achieving Agreement goals and programs are rare. Also, many sponsors have difficulties in planning and assuring resources for such long-term efforts.

Notably lacking are opportunities for joint U.S./Canadian funding of research and exchange of researchers. There are cooperative programs, but these are characterized mostly by agency groups which usually work in an independent manner. Cross funding and exchange of researchers may require legislative initiatives, but these initiatives would be worthwhile. We need to overcome the limitations of the grant and subvention systems of the United States and Canada as to how and when funds are dispensed and the problems of funding across fiscal years, which for the two countries have start and drop dates six months apart.

There are a number of engineering sciences research needs I would like to suggest. First, the Commission has pointed to a need for new, improved and broadly applicable treatment processes for toxic substances. The three major treatment processes, activated carbon absorption, incineration, and burial at land sites, all have limitations. The "conventional treatment processes" which are used in sewage treatment plants occasionally can treat some small component of toxic substances passing through the plant, but in general these substances pass through treatment plants untouched, or are transferred intact to sludges for incineration or burial. In a few instances the treatment

plants act to concentrate these materials, producing an effluent, or sludge, more toxic than before treatment. There is a special need to encourage research that would develop methods of using sludges as the raw materials for useful commercial processes and products, thus converting pollutants to resources.

Second, there is a need to improve the operations of older sewage treatment plants to be more effective treatment works, especially when construction of new replacement plants would be prohibitive due to such factors as availability and cost of land.

Third, among the very promising ideas meriting research and development are "living filters" for the "biological polishing" of effluents before discharge to rivers and lakes. These "filters" augment waste treatment in the same way that wetlands and bogs trap pollutants and filter water through complex plant-animal systems. The "filters" might assure that processed effluents are not biologically disruptive of receiving waters.

Fourth, flow management and control, to prevent upsets in treatment works from overloads, should be studied at all operating scales of treatment. Not every system can have a Chicago deep tunnel system or flow equalization tank.

Fifth, improved processes to recycle water and reduce intake and effluent discharges in industrial, and agricultural operations should be developed. Recycling reduces both costs of operation and pollution control, while reducing the amount of pollution.

Sixth, product substitution, a research area of great importance, is the development of less polluting products to substitute for currently used, high polluting products. Legal incentives, notably registration laws for agricultural chemicals, have made product substitution a way of life for the pesticide industry. For other substances, the main incentives are market factors.

Within the physical and biological sciences, much of the research needed expands current activities. I shall give two examples. First, there is a continuing need for inexpensive, short-term toxicity tests with long-term predictability. Second, there is a need to improve the standardization of analytical methods which quantify the presence of many new and well-studied chemicals at very dilute concentrations in water, biological tissues and sediments.

I would like to make a personal observation about the way research programs fit into the American federal agency structure. During my tenure on the Commission there has been ongoing debate within federal agencies as to whether or not Great Lakes research should be recognized as a discrete research need and program activity. My personal view is that it should be. The Great Lakes, with their massive supply of fresh water and consequent slow flushing time constitute a unique system deserving of special research considerations. I, for one, am delighted to see Congressional action aimed at recognizing the unique quality of the Great Lakes system.

While this conference is concerned with the Great Lakes generally, and Lake Michigan in particular, the Commission is of the belief that we must transcend local or regional considerations, and recognize that the problems you are addressing today are transboundary, multimedia, and of concern beyond the Great Lakes basin. Toxaphene, an insecticide used in the southern United States, has been detected in the Great Lakes basin, transported by air currents across many political and watershed boundaries. Industrial solvents buried in landfills leach through the soil and become toxic chemicals in groundwater, and eventually can pollute nearby rivers and lakes. In many respects, more stringent surface water quality controls enacted in past several decades have encouraged a shift of pollution from direct surface water discharge to other routes of entry such as the atmosphere and groundwater.

The transboundary and multimedia features of the toxic substances problem demand a more holistic, cooperative, integrated, and multidisciplinary approach than heretofore realized. Our understanding of environmental problems is inadequate, and existing legislation and regulatory practices may not fit the task before us. We need both a comprehensive control strategy for toxic substances, and an adequate system for monitoring the transboundary migration of toxic substances, including the well-publicized problem called "acid rain."

Research needs always exceed existing research activities. Each new research project generated additional needs. The Commission recognizes these facts as basic to the nature of research and inquiry. What the Commission would like to see is more focused and flexible research management practices combined with research addressing Agreement related needs.

We have all heard the questions: "Can we eat its fish?" "Can we swim in it?" "Can we drink it?" We need to encourage research that answers these questions.

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GREAT LAKES FISHERIES:
A SUCCESS STORY BASED ON
COOPERATIVE POLICIES, PLANNING, MANAGEMENT AND RESEARCH

Carlos M. Fetterolf, Jr.
Executive Secretary
Great Lakes Fishery Commission

On behalf of the Great Lakes Fishery Commission I'm honored to address this gathering of people so deeply involved with the welfare of Lake Michigan. Two of the four United States Commissioners are from states which border Lake Michigan, Jim Ridenour, Director of the Indiana Department of Natural Resources, and Claude VerDuin of Michigan, who represents Great Lakes commercial fishery interests. Both men planned to attend but just couldn't make it. In the next few minutes I'm going to give you a brief fishery and environmental history; provide a little insight into the Fishery Commission's philosophy of policy, planning, and management; and quickly outline the Commission's current and future research direction. I hope the three sketches add up to a lot you'll remember.

FISHERY AND ENVIRONMENTALLY HISTORY

Henry David Thoreau wrote, "A lake is the landscape's most beautiful and expressive feature. It is the earth's eye; looking into which the beholder measures the depth of his own nature." A few years ago, as beholders looking into the Great Lakes as the earth's eye, Canadians and Americans had to share the shame because of man's exploitive nature and ignorance as to how we should care for the ecosystem.

A litany of our mistakes would include the ways in which we deforested, farmed, dammed, polluted and fished that caused the changes that eliminated the Atlantic Salmon from Lake Ontario as early as the 1980's. We've continued to lose fish species from the Great Lakes, right through 1960 when the blue pike disappeared from Lakes Erie and Ontario. Never heard of blue pike? For a few years in the middle of this century it was the most valuable commercial species in the Great Lakes.

The sea lamprey, native to the Atlantic Ocean, feeds by attaching to other fish with its suctorial mouth, and extracting body fluids. A sea lamprey may kill as much as 40 lbs. of fish in its adult life. Sea lampreys probably entered Lake Ontario via the Hudson River and its extension, the Erie Canal, opened to Lake Ontario in 1819. It gained access to Lake Erie via the Welland Canal around Niagara Falls in 1829, and spread to Lake Superior by 1946. Through a combination of heavy fishing pressure and sea lamprey predation, the lake trout commercial catch from Lakes Michigan and Huron, which had averaged 13 million pounds for many years, dropped to zero.

With the demise of the primary predators, the alewife, another invader from the sea, multiplied explosively and suffered massive die offs. Their carcasses plugged water intakes, clogged boating channels and turned swimming beaches into fish chowder.

We were also adding high phosphate detergents to our already antiquated and overloaded sewage treatment plants. This resulted in local foam problems. A combination of factors involving over-enrichment of the lakes, resulted in widespread filamentous algae problems along many shorelines. Beaches were closed to swimming, and there were short filter runs at public water supply treatment plants.

However, a worse insult was in the making -- heavy metals, noxious chemicals and the persistent pesticides you've heard so much about from previous speakers. Fish are excellent indicators of ecosystem health because they reflect the quality of their habitat. Fish accumulate the history of their habitat experiences and even concentrate many contaminants to which they are exposed. For example, two total ion chromatograms of flesh from two samples of lake trout of similar age and size can show striking differences. The analysis of broodstock from a Michigan hatchery on a protected watershed show only a few peaks, while the analysis of Lake Michigan lake trout show some 240 peaks. This illustrates two points about chemical analysis. The peaks that indicate contaminants have not been quantified or identified, and their significance to the fish and their consumers is unknown. But it demonstrates how effectively fish can bioconcentrate and accumulate.

One more piece of fishy history. The fish community of Lake Michigan, as measured by the commercial catch from 1890 through 1980, shows irregularly recurring ups and downs. This reflects many things, of course, such as market demand and monetary return to the commercial fisherman, changes in habitat quality, loss of habitat, interspecies competition and regulation by agencies. The endemic species have all had very low periods: the chubs in the 1970's; the whitefish in the late 1950s and early 1960s; lake trout in the 1940s; and the lake herring and yellow perch in the 1960s. The introduced species have taken advantage of these voids. The alewife since the 60s and the smelt since the 50s. The point to remember is that fish populations are going to change and fluctuate, both normally and as a result of man's mistakes, as well as man's successful management. Commercial fishing is a legitimate use of the fishery resource and provides a way for the non-fishing public to share in the revitalized Great Lakes fisheries. Also remember that most commercial and recreational fishing can be compatible if governed by knowledgeable regulation and backed by adequate enforcement.

When I compare the magnitude of the changes in the lakes water quality and fisheries, with the lag time in response to management programs, I see a parallel between the lakes and their managers and the small boy with a huge dog on a leash. He's waiting to see where the dog wants to go so he can take him there. Fortunately, mankind has now demonstrated the ability to correct as well as create the problems. Against this background, the state, provincial and federal governments of Canada and the U.S. are performing a

great scientific experiment that has turned the lakes and the fisheries into priceless assets recognized once again as the finest sweetwater resources in the world.

COOPERATIVE POLICIES, PLANNING AND MANAGEMENT

Efforts to establish international fishery commissions and/or effective complementary regulations and management programs for Great Lakes fisheries failed repeatedly from 1893 to 1952, but the invasion of the sea lamprey was recognized as an impending international catastrophe for the fisheries. This threat provided an added incentive to recast and complete earlier negotiations, and the Convention on Great Lakes Fisheries was entered into force in 1955. The Convention established the Great Lakes Fishery Commission to formulate fishery programs, determine the best management measures, coordinate and undertake research, make recommendations to and advise the governments, to publish, and to control the sea lamprey so there could be fishery programs. Only by working closely with the state, provincial and federal fishery agencies could this be accomplished. The Commission prides itself on the working relationships which have been established over the years. Our cooperators believe that the Fishery Commission provides them a solution to management of transboundary resources.

The Commission (see Figure 1) carries out its responsibilities for sea lamprey control and research through its contract agents, the U.S. Fish and Wildlife Service and Fisheries and Oceans Canada. The most important control technique is the application of a chemical selectively toxic to lamprey (TFM) to the tributaries in which sea lamprey larvae develop in from 3 to 17 years as harmless filter-feeders, before transforming to the parasitic phase and moving to the lakes.

Emphasis in the program is shifting toward integrated management involving barrier dams with built in lamprey traps, sterile male techniques, attractants and repellents, development of new bottom-release formulations of lampricides, trapping of spawning phase adults in tributary streams, and stocking of different strains of lake trout to find those most apt to survive a sea lamprey attack.

The Commission pursues much of its program through a committee structure involving representatives of the academic community agencies with mandates for fishery management and research.

The Habitat Advisory Board advises the Commission on a wide range of fishery-related habitat and water quality and quantity issues. HAB assists the Commission in its role as an advocate for fishery resources, and as a catalyst for the development of improved habitat assessment and management capabilities.

The Commission depends in part on its Board of Technical Experts for advice; for synthesis of scientific, social, and economic opinion; and for the vetting of research proposals and recommendations on publication.

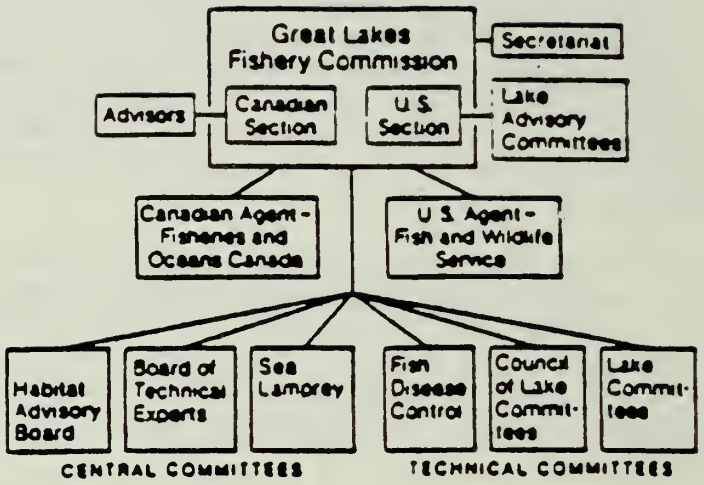

Figure 1. Organizational chart of the Great Lakes Fishery Commission

The lake committees have a major role in transboundary issues. A lake committee is made up of senior staff member from each agency administering the fishery, assisted by experts and advisors from all agencies concerned. The lake committees coordinate studies and encourage the implementation of their findings. They're on the management/research firing line. They appoint internal technical committees to advise them on transboundary fishery issues such as coordination of forage base assessment and stocking programs, calculation of total allowable catch for critical species, determining minimum size restrictions, allocating harvest among jurisdictions, choosing genetic strains for stocking purposes, and developing tactical management plans for various species. The lake committees and their subgroups coordinate research on each lake.

A few years ago the lake committee members petitioned the Commission to create a Council of Lake Committees to address specifically those matters which are of concern on more than one lake. Recognizing that threats to the fishery resource and opportunities for managing the fishery require greater capability than any one agency or government can provide, the Council's first recommendation was that the Fishery Commission develop a Joint Strategic Plan for Management of Great Lakes Fisheries. As in so much of its work, the Commission agreed to facilitate the joint efforts of its cooperators, to provide guidance at the policy level; and to require a neutral, resource-oriented forum in which mutually beneficial programs could be developed. The Commission secured the commitment of 11 agency directors to develop the plan, and constituted them into a Committee of the Whole with powers of final veto. Two years later the agencies signed their own Joint Strategic Plan for Management of Great Lakes Fisheries. The acronym is SGLFMP.

The plan strives: "To secure fish communities, based on foundations of stable self-sustaining stocks, supplemented by judicious plantings of hatchery-reared fish, and to provide from these communities an optimum contribution of fish, fishing opportunities and associated benefits to meet needs identified by society for: wholesome food, recreation, employment and income, and a healthy human environment."

The agencies identified five general issues: lost-fishing opportunities, unstable fish communities, inadequate environmental quality, conflicts and competition among users, and inadequate access to the resource.

The plan provides four strategies for dealing with the issues and achieving the goals.

The first is consensus. "Consensus must be achieved when management will significantly influence the interests of more than one jurisdiction."

A second strategy is accountability. "Fishery management agencies must be openly accountable for their performance." Each agency will keep others informed of their programs, operational objectives, targets, and performance.

The third strategy is environmental management. "Fishery agencies shall endeavor to obtain full consideration by the Great Lakes environmental management agencies of the potential impacts of their activities and decisions on fishery needs and objectives." Many current fishery problems are environmental quality problems. Fishery agencies often lack jurisdiction and adequate influence over environmental management decisions. This strategy encourages the fishery agencies to work with the environmmental agencies to identify the impacts of environmental actions on the fishery resource. We are working on this through the HAB and the Lake Committees to insure that fishery interests are at the negotiating table when the high stakes environmental decisions are made.

The fourth strategy is management information. "Fishery agencies must cooperatively develop means of measuring and predicting the effects of fishery and environmental management decisions."

The plan lays out strategic procedures for lake committees, fishery agencies and the Commission. Using this plan for guidance, the agencies and Commission can ensure that the public's fishery resource receives full consideration with other uses of our Great Lakes.

Also working with its cooperators, the Commission has developed a policy to address the transboundary common stock issues of rehabilitation of self-sustaining populations of lake trout. The policy statement emphasizes that the primary purpose in selecting stocking sites should be to obtain successful reproduction. A secondary purpose may reflect immediate-term social and economic considerations, but raising user expectations for the long term should be avoided. Although substantial stocks of lake trout have been re-established in Lakes Superior, Huron and Michigan, the policy emphasizes that the present stocking program in light of total mortality is inadequate to establish the desired level of natural reproduction. Other points are that: stocking rates and sites must be developed cooperatively among fishery management agencies, genetic constitution of broodstock should be reviewed periodically along with behavioral characteristics of their progeny, and that research emphasis should continue to be on factors limiting natural reproduction. In the area of management, the policy highlights control of exploitation, ensuring adequate escapement of mature fish, adoption of allocation criteria among users, and the implementing of monitoring programs necessary to meet objectives.

You heard Governor Thompson this morning refer to Illinois' part in the Lake Michigan fisheries plan. Each lake committee, using the policy for guidance, has developed its own Lake Trout management plan to achieve self-sustaining stocks. The plans recommend broodstock strains, size and age for planting, habitat selection for planting sites, development of refuges and rehabilitation zones, stocking densities, species interaction guidelines for prey fish and sea lamprey, allowable catch and commercial bycatch, methods of evaluating the experimental management initiatives, and methods of evaluating overall performance. Each committee explicitly identifies unacceptable levels of exploitation and total mortality.

The Fishery Commission has also developed policies on construction of low head barrier dams to prevent sea lamprey from reaching spawning grounds, integrated management of sea lamprey, and studies of impacts of lampricides. All of these policies have been developed in concert with its cooperators. Perhaps the Commission's philosophy could be described as agreeing that the quality of a consensus decision is much more important than the correctiveness of an individual position.

RESEARCH

Over the last several years the Commission has spent about $1.8 million on the research and demonstration programs for registration of lampricides. These include acute and chronic toxicity to a variety of plants and animals, evaluation of effects on non-target species, measurement of environmental fate of lampricides, and accumulation and elimination of residues. These studies will apparently continue indefinitely, because the registration agencies come up with new requirements as quickly as we can satisfy the old ones. Almost all of the registration research is done at the U.S. Fish and Wildlife Service National Fishery Research Laboratory, La Crosse, Wisconsin.

The Commission also has a general research yearly budget of about $250,000. This is to do the little projects "that need doing," and to provide seed money for studies leading to larger projects. The major purpose of the research is to learn more about the Commission's major areas of concern; sea lamprey, sea lamprey/fish interactions, lake trout reproduction and behavior, and fish community composition. Examples of recent contracts deal with predator/prey interactions, genetic identification of fish stocks using mitochondrial and nuclear techniques, use of hormones to control reproduction and matamorphosis in sea lampreys, applying chromosome banding techniques to stock identification in lake trout, and investigations into economics of Great Lakes fisheries.

Most of the ongoing sea lamprey research by the Commission's contract agent, the Fish and Wildlife Service, is done at the Hammond Bay Station on northern Lake Huron. Projects underway involve new formulations of registered chemicals for use as selective bottom toxicants, development of the sterile male release techniques, investigations of new chemicals for use as lampricides, evaluating effects of sea lamprey attachments on different genetic strains of lake trout; use of light in trapping techniques, and design of field experiments using attractants and repellents. The Station also aids the control units with technical problems.

To ensure continuing development of knowledge, a synthesis of what is already known, and to ensure that the Commission and its cooperators are prepared to take advantage of the improving habitat quality as water management programs are implemented, the commission promotes a series of symposia through active participation and varying degrees of financial and developmental support. The major symposia include 1971, Salmonid Communities in Oligotrophic Lakes (SCOL); 1976, the Percid International Symposium (PERCIS); 1979, the Sea

Lamprey International Symposium (SLIS); 1980, the Stock Concept Symposium (STOCS); 1984, Conference on Lake Trout Research (CLAR), and three major efforts in 1985, Stock Assessment and Yield Prediction (ASPY), Workshop on Estimating Sea Lamprey Populations (WESLP), and SAFR, the Socioeconomic Assessment of Fishery Resources.

The steering committees for these symposia are required to recommend research priorities identified at the meetings. Further, the Commission periodically conducts internal and external audits of both its sea lamprey control and research programs. These reviews also result in recommendations for research priorities. When research programs are reviewed two to four years later, the new research direction recommended earlier is usually very identifiable.

THE PRODUCT

It is difficult to separate research from experimental management in this, one of the world's largest scale biological experiments ever attempted. We manage a marine invader, the sea lamprey, and are rehabilitating the fishery resources in 95,000 square miles of connected waters, while balancing the predator/prey relationships largely through stocking and regulation of commercial and recreational catch.

Have we been successful? So far, yes.

From a condition that can only be described as devastated, development of the fisheries has been spectacular. The total economic impact of the Great Lakes fisheries was estimated at $1.16 billion in 1979 ($1.0 billion recreational and $160 million commercial). In 1980, sport fishing effort was estimated at 55 million angler days involving total trip and long term expenditures of $1.8 billion.

The current value is a sign that the fishery and environmental management and research programs of the eight Great Lakes states, the Province of Ontario, the U.S. and Canadian federal governments, the GLFC, and its sister commissions have been effective in rehabilitating to a point the distressed ecosystems of the Great Lakes.

Sea lamprey continue to be a serious problem in Lakes Ontario and Huron. The need for control has been demonstrated in Lake Erie for the first time, and control will commence in 1987. There is concern that large populations developing in the St. Marys river (the outlet of Lake Superior) are not vulnerable to current control techniques and that greatly increased efforts will have to be employed to protect the Lake Huron fishery.

What are the biggest research and management needs? In my personal opinion, they are in keeping the persistent chemicals and other contaminants out of the lakes, understanding the significance of contaminants in the system, and evaluating the effects on human health of consuming the contaminated fish.

Chemical residues in Great Lakes fish cast a pall over the social and economic aspects of Great Lakes fisheries. They have created a very real problem for commercial fisherman, processors, and retailers; cast a shadow of doubt in the minds of every consumer and recreational fisherman; raised an added question for the fishery manager; been a symbol of defeat for the pollution control agencies; and provided a mark for every environmental management critic to flaunt as an example of the failure of the regulatory system. Contaminants deny us full use of the Great Lakes fishery resources. For example, American eels that were recently the most valuable commercial fish in Lake Ontario at $4-5 per pound, can no longer be sold because of mirex and PCB residues.

We need long term epidemiological studies on populations of people who consume large amounts of Great Lakes fish. We need to put these concerns to rest.

But, despite the bad points--perhaps if we looked today into that part of the earth's eye we call the Great Lakes, we would measure the depth of our own nature with less shame than two decades ago--and maybe we would even have a touch of pride. I know that all of us associated with the lakes have a better feeling about ourselves now than we did. Let's keep up the good work so we can be proud to leave to future generations a legacy of management based on preventive programs rather than remedial ones.

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OPENING SESSION

OPENING ADDRESS

HONORABLE ROBERT ORR
GOVERNOR
OF
INDIANA

ROBERT D. ORR

GOVERNOR, STATE OF INDIANA

Robert D. Orr is serving his second term as governor of Indiana. He was first elected governor in 1980 and reelected in 1984.

During his two terms, Gov. Orr has introduced new programs to foster economic development and to create jobs for thousands of citizens.

In addition, he has implemented changes in the educational system to decrease class sizes in the primary grades and improve early childhood learning. More stringent graduation standards have been adopted for high schools, funding for teacher salaries has improved, and tax credits for corporations that donate computer equipment to schools have been initiated.

Prior to his election to the top statewide office in 1980, Gov. Orr was Indiana's lieutenant governor, during which time he served as head of the state's commerce department, as senate president, and as commissioner of agriculture.

Gov. Orr is a member of the Amtrak board of directors, by appointment of President Ronald Reagan. He is a member of the National Governors' Association, and serves as chairman of the Transportation and Commerce Committee. He is also a member of the NGA's Technological Innovation Task Force and the Acid Rain Task Force.

Gov. Orr received an A.B. degree from Yale University in 1940 and attended the Harvard Graduate School of Business.

OPENING ADDRESS

HONORABLE ROBERT ORR
GOVERNOR OF INDIANA

It's impossible. That's what a lot of people said during the 1950s and 1960s. It's impossible. That's what a lot of people believed during the 1950s and 1960s. But they were wrong.

They were wrong about the potential of what was considered by many to be a large group of polluted lakes. The majority was wrong about the public's interest in reviving the Great Lakes. "It's impossible," they said. "The lakes are lost forever."

But as someone once said, the impossible is often the untried. And today, after years of intense effort, the Great lakes are great once more.

This has been no small accomplishment, for at the same time we cleaned up the lakes, we enjoyed significant economic growth. No small accomplishment indeed, this balancing act of environmental and industrial interests. And in Indiana, we're doing it as well as anyone.

In traveling around the country, I'm continually amazed by some people's response when I talk about Indiana's 45-mile Great Lakes shoreline. Quite frankly, many people don't know that Indiana is on the Great Lakes. I think a lot of people are under the impression that we're located somewhere near Kansas or Nebraska.

Illinois' shoreline isn't much longer, but people have no such problem remembering Illinois is a Great Lakes state. I'm sure that's because of the image they have of the great city of Chicago: An image of multi-colored sailboats sailing past its majestic skyline, the sun setting behind the Loop and Gold Coast, casting long shadows over Lake Michigan, Lincoln Park and the Oak Street Beach. It's a powerful image.

But flying up here yesterday, I was struck by another powerful portrait painted below on the Indiana shore. There, perched upon the blue waters of Lake Michigan, is the very shadows of U.S. Steel's Gary Works and America's most heavily concentrated steel-producing region, lie the Indiana Dunes National Lakeshore and Indiana Dunes State Park. There, the power and majesty of American industrial might stands side-by-side in peaceful coexistence with one of the most beautiful land forms on the Lakes -- a tribute to human intellect and human willpower. Remember, they said it couldn't be done.

But, thanks largely to the efforts of a fine Illinois statesman, Senator Paul Douglas, the national lakeshore became a reality. Today, the state and national parks at the Indiana Dunes attract more than 2 million visitors a year, many from right here in Chicago.

We in Indiana owe a debt to Senator Douglas for his cooperation and bipartisanship in guiding the national lakeshore legislation through Congress 20 years ago. It is in that same spirit of interstate cooperation that we gather today at the initiative of my good friend, Governor Jim Thompson -- another great Illinois statesman.

When I met with my fellow Midwestern governors last month at Mackinac Island, I suggested people stop calling our region the Rust Belt or Frost Belt and instead refer to it as the "Water Belt". (A Michigan newspaper did me one better and suggested we call the Sun Belt the "Parch Belt".)

The obvious inference in thos two monickers is that we have something they don't have in the Sun Belt -- an abundance of fresh water. We have our economic "ace in the hole," the Great Lakes. Our economic past was built around them. Our future depends upon preserving them.

The visionaries of 20 years ago, many of whom sit in this room today, recognized that responsible use of this precious resource was critical to our future. And look what has happened in those 20 years:

Twenty years ago, rivers like the Detroit, St. Clair and Calumet were sinks into which the steel, chemical and auto industries dumped their wastes. Today, the levels of DDT, PCBs and mercury in our Great Lakes have been reduced anywhere from 70 to 95 percent.

Twenty years ago, the U.S. dumped about 20,000 tons of phosphorous into the Great Lakes. Today, it's less than 3,000 tons. That's an 85 percent reduction.

Twenty years ago, municipal facilities dumped 250,000 lbs. of conventional pollutants into Lake Michigan every day. Today, it's less than 100,000 lbs. During the same time period, the federal and state governments invested more than $6 billion to build or upgrade more than 800 treatment facilities in the Great Lakes Region.

Twenty years is but an inch on the timeline of the industrial age. Even more remarkable is that the political will continues to exist to ensure the environmental quality of the lakes. When history is written, the breathing of life back into the Great Lakes will be regarded as a monumental achievement.

As you know, Indiana's stake in protecting nearly one-fifth of the world's freshwater is substantial. Out of Indiana's more than 36,000 square miles of land, nearly 4,000 lie within the watershed of the Great Lakes. Within this portion of Indiana, 1.4 million Hoosiers live, work and play.

A majority of Indiana's industrial cities are within the Great Lakes Basin, including Fort Wayne, Elkhart, South Bend, Hobart, East Chicago, Michigan City and Gary. The necessity of protecting the environmental quality of this basin, both for today and future generations, cannot be overstated.

For although we're running headlong into a high-tech future where more and more people will hold service jobs, it is manufacturing which will continue to produce real wealth and the majority of jobs for our citizens. And manufacturing, whether it be in a foundry in South Bend or a General Motors plant in Fort Wayne, needs water just as much as an Indiana cornfield.

Think about this: One-fifth of all U.S. industry is located on the Great Lakes. Hundreds of industries and power plants take billions of gallons of water daily from the five lakes for such uses as recycling waste and cooling their equipment and products. Our ability to keep wealth-creating manufacturing industries on the lakes and tributaries is tied directly to our will and ability to preserve this most precious of our resources.

Our friends in the South realize it. About two weeks ago, a Sun Belt congressman from California tried to get his region's foot in our door, or I should say, in our water.

He offered an amendment on the study of interbasin transfer of water as the House Committee on Interior and Insular Affairs considered a water resources bill. The amendment would have authorized the secretaries of the Army and Interior to undertake a study of water transfer if they found it in the "national interest." Also included was a requirement that the secretaries "communicate" their intentions to Congress and the governors of the affected states. It didn't say the governors would have to approve, just that they would have to be notified.

Thankfully, Indiana Congressman Peter Visclosky, whose district includes most of the Indiana shoreline, worked hard to keep the amendment off the bill.

With areas of the Sun Belt now desparate for water to sustain their growth, there likely will be other attempts to divert waters from the Great Lakes -- attempts not necessarily concerned with the best interests of the Great Lakes or the environment. I'm confident Congressman Visclosky and his Great Lakes colleagues will continue their vigilance. To be sure, Great Lakes governors will.

The action by Great Lakes Congressmen to block this latest attempt was an example of the kind of interstate cooperation needed to protect the Great Lakes.

My administration, and the Indiana General Assembly, have been strong supporters of such efforts. The signing of the Great Lakes Charter last February was, in fact, more than the signing of a document. It was an occasion that recognized the common interests and interrelated histories of eight states and two Canadian provinces. Just as the Great Lakes have been a part of our past, so should they be recognized as an integral part of our future.

I've focused my remarks on balancing the interests of industry and nature, and the vital economic importance of Great Lakes water to American industry.

But the lakes are, of course, vitally important to our economy and quality of life for other reasons as well.

Today, there is a renewed interest and a greater appreciation of the economic benefits to state and local economies from increased recreational use of our shoreline. Unlike some coastal states whose shorelines are primarily in private hands, Indiana does have almost half of its shoreline in public ownership. This makes the wonder and beauty of Lake Michigan accessible to all Hoosiers.

An estimated 100,000 anglers fish in the Indiana waters of Lake Michigan each year. Their activities generate an annual economic impact in the neighborhood of $50 million.

Indiana sport fishing supports a 60-boat charter industry and creates a major tourism draw for Northwest Indiana. A 1981 study by just one Indiana community, Michigan City, concluded that the impact of boating upon the local economy ranged from about $13.4 million to $17.4 million annually.

Many of the fish caught by these sportsmen are the result of stocking programs by Illinois, Michigan, Wisconsin and Indiana, which put about 15 million trout and salmon into the lake each year. This is a success story worth mentioning.

We have gone from a period of ecological chaos and deterioration in the 1940s, '50s and '60s, to an era of intensive management and wise use of our fishery resource. Think back to a time when the alewives clogged intake pipes and washed up on our beaches by the thousands. Today, thanks to successful efforts to control the sea lamprey, trout and salmon stocked by the Great Lakes states flourish and feed upon the once useless alewife.

In fact, alewives have become the fuel for a trout and salmon program that has been hailed as one of the great fish management stories in history.

This, too, could not have been accomplished without interstate cooperation.

Those of you here today who had anything to do with the rebirth of the Great Lakes can look upon your accomplishments with great pride, and look ahead to the future with eager anticipation. Those of you who are new to this cause, I am convinced that the future holds great challenges and even greater rewards as much work remains ahead.

I am reminded of a story about Winston Churchill near the close of the Second World War. He was visited by a delegation from the Temperance League and chastised by one woman who said, "Mr. Prime Minister, I've heard that if all the whiskey you have drunk since the war began were poured into this room, it would come all the way up to your waist." Churchill looked dolefully at the floor, then at his waist, then up the ceiling. And he said, "Ah, yes, madam. So much accomplished; so very much more left to do."

Yes, we have much left to do, and while I'm excited about what has happened on Lake Michigan and the other Great Lakes, I know full well of the challenges that lie before us -- challenges to maintain that delicate balance between industry and environment, challenges to maintain and use the Great Lakes as our economic "ace in the hole," challenges to keep our lakes a sportman's paradise.

If these challenges ever look impossible, we mustn't get discourged. All we need to do is think back to the 1950s and '60s.

It's impossible, they said.

Just remember, they were wrong.

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GENERAL SESSION ON WATER

AND

LAND USE AND DEVELOPMENT

GEORGE A. RANNEY, JR.

INLAND STEEL COMPANY

George A. Ranney, Jr. was named to the newly created post of vice president, materials and energy, for the Inland Steel Company in April, 1985. This assignment added purchasing, coke and iron production, energy, and traffic to his previous responsibilities as vice president, raw materials. Since 1980, Mr. Ranney has been responsible for Inland's coal, iron ore and limestone operations, and its fleet of Great Lakes boats.

Prior to his current position, Mr. Ranney served as secretary of the Inland Steel Coal Company in Sesser, Illinois. He joined Inland in 1973 as counsel in its legal department. From 1969 to 1972, Mr. Ranney served as deputy director of the Illinois Bureau of the Budget and as assistant to Governor Richard B. Ogilvie for taxation, transportation and social services. In 1978, Mr. Ranney was appointed chairman of the task force on the future of Illinois by Governor James R. Thompson.

He currently serves as a member of the board of the Center for the Great Lakes and has previously served as president of the Metropolitan Planning Council. In addition, he chaired the governor's task force which recommended creation of the Regional Transportation Authority for northeastern Illinois and headed the referendum campaign for the RTA.

Mr. Ranney graduated with high honors in history and literature from Harvard College in 1962 and was awarded a Shaw Fellowship by Harvard for a post-graduate year of study abroad in 1962 to 1963. He attended the Hotchkiss School and the Westminster School in London, England. Mr. Ranney graduated from the University of Chicago Law School in 1966.

He has taught courses at the University of Chicago on law and transportation as a member of the faculty committee on public policy studies. He has also served on visiting committees for the Kennedy School of Government and the law school at Harvard University, and on three visiting committees at the University of Chicago.

PETER J. VISCLOSKY

UNITED STATES HOUSE OF REPRESENTATIVES

Peter J. Visclosky is the United States representative from Indiana's First Congressional District. He is a resident of Merrillville, Indiana, and is serving his first term.

Congressman Visclosky is a member of the Committee on Public Works and Transportation and the Committee on Interior and Insular Affairs. He serves on the subcommittee on economic development and the subcommittee on water resources of the Public Works Committee. In addition, he is a member of the subcommittee on national parks and the subcommittee on general oversight, Northwest Power and forest management of the Interior Committee.

Congressman Visclosky graduated from Indiana University in 1970 with a bachelor's degree in accounting. Following his studies at Indiana University, he entered the University of Notre Dame law school. In 1972 he served as as legal assistant in the Manhattan (New York City) district attorney's office.

He received his Juris Doctor degree in 1972 and practiced law with the firm of Benjamin, Greco & Gouveia through 1976. Congressman Visclosky served the late U.S. Representative Adams Benjamin, Jr., during his entire tenure in Washington, D.C., and served as associate staff to the U.S. House of Representatives' Committee on the Budget.

In 1982, Mr. Visclosky was chiefly responsible for the staff work leading to the creation of the Calumet Forum which was co-founded and developed by Congressman Benjamin and Lt. Governor John M. Mutz. The Calumet Forum was the first region-wide partnership of labor, business, government and academia established to improve the economy and quality of life in northwest Indiana.

While in Washington, D.C., Mr. Visclosky attended the Georgetown University Law Center and in 1982 received an LL.M. degree in international and comparative law. He also taught a graduate course at Georgetown University.

During 1983 and 1984, Mr. Visclosky again practiced law with the Merrillville firm of Greco, Gouveia, Miller, Pera & Bishop, where he was engaged in the general practice of law.

Congressman Visclosky is a member of the Indiana, District of Columbia and United States Supreme Court Bars.

DONALD F. HOLECEK

MICHIGAN STATE UNIVERSITY

Donald Holecek became an assistant professor in the department of park and recreation resources at Michigan State University in 1972 and currently holds the position of professor and director of the newly created Michigan Travel, Tourism and Recreation Resource Center at MSU.

Dr. Holecek has been involved in Great Lakes-related recreation research for over a decade, focusing particularly on recreational boating and underwater parks. His work, funded in part by the Michigan Agricultural Experiment Station, Michigan Sea Grant and the Michigan Department of Natural Resources, has contributed to the development of Michigan's expanding underwater park system in the Great Lakes and to the state's $1 billion recreational boating system.

He received his bachelor's in forestry and master's in forest economics from the University of Illinois at Urbana. He completed work for a doctorate in resource economics at the University of California at Berkeley.

DONNA W. WISE

THE CENTER FOR THE GREAT LAKES

Donna W. Wise is president of the Center for the Great Lakes, a private, non-profit organization based in Chicago. The Center was created to provide an integrated binational focus for developing effective programs to manage, conserve and develop the region's natural resources.

The scope of the Center's research includes water quality, water quantity, and economic development issues.

Ms. Wise previously served as staff director for natural resources and environment for the National Conference of State Legislatures. Before joining the NCSL staff, she was program administrator for the Illinois Coastal Zone Management Program of the Illinois Division of Water Resources, Illinois Department of Transportation. She oversaw several programs relating to the development of a state natural resource management program for the Lake Michigan shoreline.

Ms. Wise graduated from DePauw University, Greencastle, Indiana, in 1971.

WILLIAM J. BRAH

WISCONSIN DEPARTMENT OF ADMINISTRATION

William J. Brah is the chief of the office in the Wisconsin Department of Administration that assists the governor in formulating policies on a variety of Great Lakes issues. He directs policy initiatives concerning water diversion and consumptive use, water project financing and cost sharing, disposal of dredged materials, and redevelopment of underused harbors and waterfronts in urban areas.

Before coming to Wisconsin, Mr. Brah spent seven years at the U.S. Department of Commerce in Washington, D.C. He managed policy, programs and funding for the major phases of the national coastal management program.

As a consultant to the Texas Water Resource Institute before working at the federal level, Mr. Brah developed institutional strategies to control excessive ground water pumping and land surface subsidence in the Houston-Galveston area.

Mr. Brah has a master's degree in marine resource management from Texas A&M University and an undergraduate degree in political science from Regis College, Denver.

ENVIRONMENTAL PROTECTION AND ECONOMIC DEVELOPMENT - IS SYNERGY POSSIBLE?

GEORGE RANNEY
VICE PRESIDENT, MATERIALS AND ENERGY
INLAND STEEL

What I am going to do today is to speak from the heart and not from the text that I had prepared for this occasion. I'd like particularly to ask for the understanding of Mike Donahue - the very competent research director of the Center for the Great Lakes - who assisted me in putting together the text that I'm not going to use.

The reason that I'm not going to talk about facts from a more formal text is reflected on the front page of the Chicago Tribune this morning.

You will notice that it gave the news that Inland Steel had announced that it expected to lose $50 million in the third quarter, and for the first time in 51 years was eliminating its dividend. This is a company that has probably been as successful and profitable as any in the steel industry and many in basic industry. And what this news suggests, I think, is the importance of the subject that I was asked to talk about today. That is a question of the relationship of economic development and environmental protection.

The problems that Inland is facing are reflective of basic industry in this country and, in fact, I think we can put them in a broader perspective very easily, because they're in some respects related to some of the problems that I'm going to talk about.

I came here today because I do care very deeply about the Great Lakes. One of the things in which I take most pride, is that in 1970 I took out in the drafting of the Illinois Environmental legislation that created the EPA and also the Institute for Environmental Quality, which has since become the Department of Natural Resources.

That drafting was started in the kitchen of our house in Hyde Park in the southside of Chicago with two of my colleagues from law school at the University of Chicago, men who will be known to many of you--David Cury and Joe Caragonnas. I think it's a great tribute to Don Etchison and to his colleagues from the Thompson administration that they have carried on the very high standards set in earlier days by the Ogilvie administration.

The preliminary program that you may have received for this conference stated that I was going to talk about striking a balance between environmental protection and economic development. I asked that the wording of that subject be changed so it would read environmental protection and economic development.

Is synergy possible? Because I think that it's time to approach the important issue of the relationship between these two important public priorities quite differently than we have in the past. That's why I thought that using this much abused word "synergy" makes sense. I think since the dawn of the environmental movement some 15 years ago, we've tended to discuss this relationship in terms of tradeoffs or balancing one priority against another. And because language drives action and because ideas are important, people have seen these values as necessarily opposed to one another.

What I'd like to suggest today is that for the future, particularly in light of the advance of the past decade and the past five years, we should try to think about these issues differently.

And it's my conviction and that of the Center for the Great Lakes, on the board of which I sit, that consideration of both environmental and economic opportunities - together in a structured way - can make the Great Lakes, among them Lake Michigan, even more important resources than they are today.

Hence the word synergy, overused though it may be, with its suggestion that the two put together can be larger than the sum of them considered separately.

Now in the course of this conference you've heard from expert speakers far more qualified than I am to discuss important trends in the quality and quantity of Lake Michigan's water. I tried to watch this scientific evidence with as much time and expertise as I can bring to bear. But probably to my mind the most striking example of the change, of changes, was brought home to me two weeks ago when I met with the Union leadership from one of our coke plants at our steel mill in East Chicago.

We had a substantial discussion over dinner at a local restaurant of what was on their mind and what the company would be needing in the contract negotiations coming up next year. And then we opened up the subject - opened up to broader subjects - one that we spent a full 20 minutes on with a great deal of interest - and even emotion - was why the steel company wouldn't permit its employees to fish off of its docks.

A few years ago that wouldn't have been an issue. The argument of these people, which is entirely right, was that they were there in their boats - this was a superb place to be - why wouldn't we let them walk through the property on their off hours.

The perspective that I can bring to bear is based not on simply on personal observations like that, I think, but on what is driving this economic perspective that is of such great importance with respect to our lake and our regional economy, the basic industry including steel and my own company in particular.

Virtually every steel plant in the world is located on water. Inland is almost entirely dependent on iron ore mined in the Great Lake states of Michigan and Minnesota, and is shipped to us by our own fleet to East

Chicago. We use millions of gallons of water each day at our mill, which is now the largest in the country.

We depend for 90 percent of our sales on customers who are located in the states adjoining the Great Lakes. Historically this proximity to raw materials and to this midwestern industrial market has been to our great competitive advantage. We have not been alone. Seventy percent of this country's steelmaking capacity is located on the Great Lakes, and much of the industrial plan within the country is located on these lakes.

Now the reversal in our industrial economy, which I mentioned, has been unprecedented in the last 50 years. Inland is a microcosm of what's happened. Its been a pattern that's been repeated throughout the Great Lake states. We're in trouble because our customers are in trouble.

They include many firms, such as Caterpillar for example, with highly regarded management skills. The impact of this decline on our regional economy has been adverse and dramatic.

I know that there are those who will say that jobs, revenues and taxes lost in the industrial arena will be replaced in the service sector. Recent and careful economic thinking, however, suggests that it's unlikely that this is likely to be so for far in the future.

In any case, an economy based on
services alone is more fragile and more susceptible to abrupt deterioration, than one which is broadly based and includes manufacturing. Furthermore, a shift to the service economy has important consequences for disadvantaged groups in our society who have traditionally found jobs and worked their ways up in the industrial sector. And finally, if we consciously abandon our industrial base we turn our backs on a strength that has been important to this region, which we need not necessarily lose.

There have been a lot of reasons for this industrial decline. One of Thereasous people cite, and there is some justification to this, are problems with management expertise and style. But the decline has been so broad, and has affected so many different industries that it is very difficult to attribute it primarily to that.

Another reason of particular importance to steel is the extraordinary strength of the dollar in recent years, the increase of which has wiped out the 18 percent in cost reduction that our company, for example, has been able to achieve in the past 3 years alone.

There has been a related surge in imports, stimulated in part by the economic difficulties of steel companies in other countries. People generally don't know that the Japanese steel companies are operating at lower rates of capacity than the ones in this country. And they are shipping here, as are others, simply because they need the cash.

Another reason is the comparatively high-employment costs of our industries, and these are not unimportant. And an additional factor which we really need to recognize has been the cost to industry of the environmental regulation imposed in the '70s. Inland for example, spends over $40 million a year simply operating its environmental control equipment. And I know this all too well because I am in charge of it.

In the past 10 years we have spent nearly $400 million in capital on pollution control equipment. We spent $104 million in the last 4 years.

As has been reported in the press this week, we are seeking to build a new continuous coal mill in one of the Great Lake states that would cost us just about as much as the environmental control equipment we put in in recent years, and we can't afford it.

I'm not saying that it's wrong for this country to give environmental protection the priority that it's had in recent years. I think the reports to this conference will show that we've had great results from that, and we should rejoice in those.

What I am suggesting is that this environmental initiative has had its cost--and it's been substantial. And this is a cost that's been borne not only by the employees and stockholders of our industrial companies, but also by their families and by the residents of the communities in which they're located; in fact, borne by the taxpayers who depend on these companies as well.

What can we learn from this experience? I think there are a number of things and there are going to be a number of instances in which we can test the approach that I'm suggesting in the future. There are clearly going to be issues relating to further restrictions on the environment of the same kind that we have seen in the 70's.

Let me give you a specific example here. Inland sits on the Indiana Harbor Ship Canal. This is an area that when all is said and done, has been badly polluted over the years. Governor Orr referred to the importance to his state of that area. Dramatic and frankly quite unexpected progress has been made in cleaning up that area. But it's far from swimmable.

In light of the progress that's been made, there are increasing suggestions that what ought to happen is that it ought to be continued, speeded up, and in fact that water should be cleaned to the extent that it be made swimmable.

I would suggest that before we revise standards to go that additional distance, we take a very careful look at what the implications of that kind of thing might be--there and elsewhere.

I know you've given substantial attention to the whole question of toxic pollution. And there is no question to my mind that this is a very serious problem.

It is one, however, that as your own analyses have indicated, falls into different and sometimes distinct areas--aquatic life on the one hand, human dangers on the other. Clearly there is going to have to be additional regulation in this area.

But as we go forward with that, I would suggest that we learn what we can from the economic impacts of the '70s and the '80s on the steel industry. The chemical companies in this country at this point are facing many of the same kinds of pressures that we are.

There is a long and very interesting article which was very reminiscent of what Inland is going through in the Wall Street Journal on Wednesday. It was about DuPont--which is still making a profit--but is also going through everything from cultural change to revised methods of doing its capital budgeting because of economic constraint.

I deal often with Union Carbide and Dow Chemical and there's an article in the paper about Olin shutting down plants and terminating 3,500 employees this morning. What I am suggesting is not that we shouldn't do the right thing, but that it's terribly important to understand the implications of what we're doing when we address this extremely important question of toxic pollutants.

And I would further suggest that we try to explore ways of financing more intelligently the kind of environmental regulation that may be appropriate so that we don't put companies under the same kinds of severe and traumatic stress that we in the steel industry have been under in the last few years.

There's also a third area that I think we can justifiably look to. That is the question of major projects, often of a capital nature, in the future. You'll be hearing some discussion of one of the easiest of these. The question of waterfront development, where obvious economic and environmental considerations can play together without the kind of adverserial situation that we see elsewhere. But there are other kinds of issues that may be of great importance and which could use a different analytical approach.

I offer as one example the question of what to do with the almost abandoned U.S. Steelworks on the south side of Chicago. There is significant acreage there that can and should be reused in an area of 40 percent unemployment. It's close to the center of Chicago and offers obvious advantages and major opportunities for a city that is having a difficult time.

A suggestion that has been made, and you may be hearing some more about, is that serious consideration be given to using that area for a major new development, possibly including its use as an airport, which might in turn require some additional landfill. What I would like to suggest is that before that opportunity is rejected because of the kinds of environmental dangers that it might pose - and I know they exist - that we analyze very carefully what the consequences both ways might make sense from both an environmental point of view and an economic as well.

Finally, there is an area that I think is of prime importance for people at this conference. And that really is in the intellectual area. It's the question of values where we have, I think, let ourselves fall into the trap of looking at these interests as necessarily competing. I think some things of interest have developed.

Amongst them, is the creation of the Center for the Great Lakes, which is trying to look at the kinds of issues I'm talking about in a different way from joint perspectives - with synergy in mind, if you will.

In 1983 there was a very important congress sponsored by Detroit Edison on the economic future of the Great Lakes. This conference is also an important one. I say this with sincerity because I spent so much time working on Governor Thompson's Task Force on the Future of Illinois, which promulgated ideas that I think have come into the mainstream for the government in Illinois. It reinforced things which need to be said.

I would hope that people like you would realize the importance of intellectual leadership because its ideas that drive action in this and in other areas. I think it's important that we not be too impatient. We may need to study and to plan in ways that in the '70s we might not have wanted to because of the apparent urgency of the situations facing us.

In the past couple of years I have been working very closely with a number of Japanese businessmen and steel consultants. We have things to learn from them because they have built facilities in recent years which we have not build because their industry had been expanding.

One of the most interesting things to me about their approach to problems is the emphasis they put upon planning. If you looked at how much time the Japanese spend on planning a project, as opposed to implementing it, you would find that they spend 70 percent of their time, I would surmise, on planning and 30 percent on implementation.

In American industry, and I would suggest in American government, we often spent 30 percent at most on planning, and 70 percent on implementation--with the result that we make mistakes. We have change orders if it's a capital project and we get initiatives going that often we have to revise as we go forward.

These revisions result in consequent problems, consequent additional costs and consequent problems for the future. What I'd like to suggest is that we apply this kind of structured and disciplined approach to the problem facing the lakes.

I know that we have in the past sensed that we needed to protect what was natural in the environment. And it has been a matter of principle for many of us, including myself with respect to the lakefront in Chicago, for example. And I also think it's worth remembering that the great protector of the

Chicago lakefront was a businessman, Abe Montgomery Ward, and that there is an important role for that kind of person today.

If you go back even beyond Montgomery Ward to the 19th Century, we may have something to learn from the great American environmental planner, Fredrick Law Olmsted. Olmsted believed that landscape architecture which was his profession was an art form in which you worked with nature and created art that was manmade. Omstead was the man who was responsible for making Yosemite into the first park set aside by the National Congress. It was his concept that there were areas that because of their scenic beauty they should be preserved in a pristine and entirely natural state.

But Olmsted was also the man who created Jackson Park on the south side of this city. He created it out of sand dunes and marshes which were unuseable by man. He dug lagoons and built islands. And what he did was to effect the creative reconstruction of the natural environment to serve the needs of an industrial society that was of great concern to him at that time because of the crowded and unhealthy nature of urban life.

I think we have something to learn from that today and as we think about the relationship of an urban and industrial life to what basic values we need to achieve in the future.

I hope that these ideas have been helpful - they reflect, as you can tell, some pretty direct and dramatic recent experiences. I really believe that if we go forward in looking at these environmental and economic questions jointly, there are ways that we can improve the quality of life in this region and use the great resource of Lake Michigan to the extent that we may never have dreamed of in the past.

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BALANCING PUBLIC AND INDUSTRIAL CONCERNS IN REDEVELOPING THE INDIANA LAKEFRONT THROUGH THE "MARQUETTE PROJECT"

HONORABLE PETER VISCLOSKY
UNITED STATES CONGRESS
INDIANA

I would like to say one thing about Governor Orr. One thing that he should be very proud of, and it has a direct impact on Lake Michigan and on the Great Lakes, is that Indiana in 1987 will host the Panamerican games, and one element of those games is the yachting competition. That yachting competition will be held in Michigan City on Lake Michigan. And the Governor, the people in Indianapolis and the people of northwest Indiana should all be congratulated for their cooperation in securing these international events, and in securing the participation of the entire state of Indiana. I would like to congratulate the Governor on that.

Two events in the early 1980s gave impetus to the idea of the Marquette Project, our unified picture as to what might happen in northwest Indiana. One was a very political event after the census of 1980 because we had reapportionment. And for the first time in many, many years we essentially had the entire southern lakeshore, with the exception of several miles out east in one congressional district. Instead of having three members of Congress represent the Indiana Dunes National Lakeshore, we now had one member of Congress representing the Indiana Dunes National Lakeshore. The Governor spoke of the five major steel firms in northwest Indiana. Instead of being scattered in two congressional districts, they were now centered in one.

The Governor remarked that Indiana produces more steel than any other state in the nation. I am proud to stand here and say that there is one congressional district in this country that produces more steel than any other state. And that's the 1st Congressional District in Indiana.

It was that reapportionment that put all of those questions, all of those communities of interest - within one congressional district that led Adam Benjamin to the next step, and that was to sit down with the state administration, with Lieutenant Governor Mutz, to talk about some joint efforts to redevelop northwest Indiana to try to create some new job opportunities in this area. And we again had that bipartisan effort along with the business community to set up what has now become the Northwest Indiana Forum.

Time passed, and during budget hearings in 1982-1983 Lester Throw from MIT came in to the House Budget Committee and brought up an interesting point. He said, "It's not the federal government's role to go into any region of the country, any congressional district or any state and say, 'You must do this.' It is for the people in that state, in that region and in that area to make that determination, and then for the federal government to help them along their path." He spoke about the miracle of New England and suggested it was

not a miracle at all that the transition from shoes, textiles and manufacturing - to high-tech, to medicine, to service was very painful; it was very traumatic and it took 50 years. It did not happen overnight.

And Throw's point was for the people of New England, in that instance, to decide where they wanted to go, and then in cooperation with people at the state levels and federal levels that would accelerate that period of time.

If we could compress it into 25 years instead of 50, we have done a very good job for the people we are elected to serve.

People talk about tourism and fishing all the time. People talk about tourism and job creation. I would fully support them. Anyone wanting to do anything in the midwest - anything positive - I'm for.

But when I talk about job creation and redevelopment along the lakeshore; when Mayor Pastrick of East Chicago, Indiana talks about along the lakeshore, what he and I think, and what Governor Orr and Governor Thompson are talking about is the quality of life. Let's not do it for somebody someplace else so they want to come to our area. Let us do it for ourselves. Let us improve the quality of life for the people we serve in our own area, and then the tourists will come.

The Marquette Project was an attempt to also bring some unity to the picture as Mr. Benjamin and Lieutenant Governor Mutz brought to the northwest Indiana forum.

Historically, one of the problems that we have faced in Indiana, and certainly in northwest Indiana, is a certain amount of diversity at the governmental level. We have a large number of cities, towns and counties, but those problems are beginning to be addressed. We now have mayors of both political parties, both black and white, and in three counties who last year came to an agreement regarding, of all things, marina development and lakeshore development, So that picture is turning.

The Marquette Project was an attempt to look at this area as a unit. We have over 500,000 people and that 45 mile seacoast, so let's do something with it.

The next step was whether to divide it into two parts or to look at the physical redevelopment. Do we also want to look at the economic side? Well, I thought about it for a while and I said, "Listen, I'm a legislator. I'm having a difficult time balancing that federal budget. Who am I to tell anyone exactly what type of job they should try to create in northwest Indiana, southeast Illinois, or the state of Michigan? Let us change the physical characteristics to allow those who are charged with that responsibility--our local economic leaders, political leaders--to go out and have something to sell."

And the point is that at the turn of the century northwest Indiana had the physical characteristics that, at that time and at that place, led to job

creation. We had the water and the dunes. We had a transportation network already in place. It was developed and it led to jobs.

If you drive through and look at northwest Indiana's infrastructure and the type of construction we have, it is to a large extent discouraging new types of job creation--those jobs that really do have some future potential to generate new money and new opportunity.

So the point of the Marquette Project is to let us public officials essentially work on physical redevelopment, and then let those charged with economic development go out and create the jobs.

Lastly, it was for more of an internal framework for decision making. In Porter County, where we have a great deal of growth, there are small plants and warehouses beginning to spring up along two-lane roads.

We now have task forces looking at hazardous waste response teams at I-94 and other highways. But those are essentially reactive. What we would like to do is to have an instrument where we can be proactive; where if you see those first couple of warehouses going up along a state road, why don't we make it four lane? Why don't we put the curbs in now? Why don't we put the sewers in now so that we can attract additional development to that area and leave other areas for different purposes?

And lastly, the name Marquette; driving up here on the Dan Ryan there is Marquette Road and Marquette Park in Gary, Indiana. Essentially, Marquette Park is just about midway between Illinois and Michigan. It's also about midway, I am told, regarding water patterns coming from the north. And lastly, it was also the first area that was set aside for public use in the state of Indiana. So I thought the term would be very appropriate.

As far as what the plan says, we would like to see 75 percent of the shoreline of Lake Michigan brought in to public access by the year 2000. At this time, the Governor suggested that about 50 percent of the shoreline was in public ownership and that about 50 percent of the shoreline is in private ownership for industrial use. Over a period of time I would like to see that pattern change, and would also caution you that the Marquette Project is not an attempt to displace steel.

But as the industry enters a period of transition, and as northwest Indiana makes a transition, and all of the people in Michigan and Illinois connected with us make that change, let us anticipate that change, and let us have more access.

In areas where we have places set aside such as Beverly Shores, an island community within the Indiana dunes, you still have problems with an access. And you're not going to displace the steelworker by doing that. You have an 11-acre tract that is owned by the B and O Railroad Company in Whiting and Hammond, and weeds are growing on it. There is not a steelworker in place. Can we in cooperation with the state transform that area and put some people to work?

As far as the general specifics of the plan, I would like to look at that area in three zones: (1) the zone north of U.S. 12 where we should exercise a special caution and look at preservation of any natural resources that are there; (2) residential and compatible commercial retail development in the zone from 12 to 20 where we would have more commercialization and some light industrial; and (3) past south of U.S. 20 we look more towards our industrial capacity.

And as things change we would implement this plan over a period of time. We are not looking to displace anyone. The example I would use would be from the city of Hammond. Hammond Lead Company has not hired any new employees over the last year, but neither have they let any go. They now produce four times more product this year than they did a year ago in an environmentally sound manner. They are in Lake County, Indiana, but are also south of U.S. 20.

It's clear that we can have those industrial and manufacturing jobs in a compatible situation with the rest of the area.

And as far as rails go, we have talked about the possible consolidation of rail lines, and are actively negotiating regarding the consolidation of several rail lines up in the Whiting-Hammond area.

And over a period of time I would certainly like to see something like Lakeshore Drive become a true lakeshore drive where citizens can drive from downtown Chicago to the state of Michigan.

Although one may see varying types of industry, residential development and natural preservation, it can become a true lakeshore drive.

And people truly appreciate that the states of Michigan, Indiana and Illinois at this end of the lake share many things in common. I must tell you I that there is a certain amount of resentment when I feel that I have to drive up to Michigan to have a burger and then I look at that 45-mile seacoast and realize that you only have one public restaurant - and not that it is on the lake - where you can have a meal and look at Lake Michigan. A 45-mile seacoast and you only have one public restaurant where you get a lake view.

If you talk about recapturing the lake for public use, I mean it to be true public use. If you have private development as far as retail, commercial development and private housing, that is just swell. But I would want to make sure that that strip north of any of that development is truly open for public use.

I would also point to the George Washington Parkway in Washington, D.C., where you have a very narrow green strip and then you have the Potomac River, yet it is open to all of the people.

I do not in any sense want to displace those who perhaps own property on the lake - one class of people for another - and still continue to exclude the general population.

And finally, when we talk about economic development and cooperation, I would look to the city of Indianapolis. They have done great and wonderful things in Indianapolis.

After I had the opportunity and privilege of speaking before both houses of the Indiana General Assembly, I went to St. Bridget's Church to see a priest that I know. I went there at lunchtime, and for all of the wonderful and great things that are happening in that city right now, they still hand out bologna sandwiches at noon because there are still a lot of people who are not working there, people who have been passed over by economic progress.

What I caution all of the audiences is that we must include organized labor, blacks, women and Hispanics in our deliberations. Because there is no point in undertaking a venture to recapture waterfront for everyone's benefit if we continue to exclude those who have not had fair opportunity before.

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RECREATIONAL USES AND DEVELOPMENT ON AND AROUND THE GREAT LAKES

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Introduction

When ENR inquired about my interest in participating in this conference, the many positive reasons for accepting an invitation ran through my mind -- an opportunity to share my thoughts on a subject, Great Lakes recreation, which has dominated my professional life. It gives me a chance to meet and learn from the many experts who are on the program and, of course, an Illinois native can't refuse the invitation of the Governor to come home for a visit. A reason why I might have declined became apparent as I began to assemble this presentation. Much of the data I sought to objectively support and intended to discuss either doesn't exist or couldn't be found. Since this information void represents an important constraint on developing a rational program for the development and management of Lake Michigan, it is important that I elaborate on the nature of this problem for a moment.

The last attempt to develop a comprehensive data base for recreational uses of Lake Michigan occurred about 15 years ago under the auspices of the Great Lakes Basin Commission. Even this heroic effort did not produce all of the basic data needed to support planning and policy formulation for Lake Michigan, and we have experienced dramatic change since the Commission published its Great Lakes Basin Framework Study Reports. There have been, for example, a couple of energy crises, major economic changes including a severe recession, a highly successful planting of salmon in Lake Michigan, changes in water quality and so on. Hence, these reports are too incomplete and out-of-date to be useful today, except possibly as a base for trend analyses. More recent studies are available, and my colleagues and I collected and revised all that we could locate. Unfortunately, they are of limited use for developing a comprehensive picture of recreation on Lake Michigan because most focus on small regions (e.g., Michigan), numbers can't be summed because of inconsistent data collection methods, and many present only aggregate data that can't be disaggregated to the coastal zone.

Finally, most of the regularly available secondary data series we have identified can't be broken down to yield data relevant to the coastal zone and/or to the Lake Michigan basin.

The information voids concerning Lake Michigan recreation, in my opinion, result from two more general problems. First, recreation has not attracted the attention of economic planners, especially in the Great Lakes states whose economies have been driven by manufacturing, agriculture and other basic industries. The recent intense competition for GM's Saturn project, as reported by the news media in fine detail, is ample evidence of the near

obsession we have with manufacturing in our economic development planning. Even when a state comes to realize a role for recreation and tourism in economic development, the single-minded response is to pump a few million dollars into the state's travel promotion programs. I've enjoyed seeing my old classmate Dick Butkus come home to Chicago. And I've also enjoyed the fantastic scenery in Michigan's latest TV spots; however, we learn in Marketing I that promotion is but one basic component of a sound marketing strategy. Investing in research and data collection is also essential to improving our approach to marketing tourism and recreation programs that include promotion campaigns.

The second reason behind the sparse information available about Lake Michigan recreation is tied to political boundaries that generate major obstacles to regional research and data collection efforts. While fish, pollutants, "Mother Nature," and even the recreating public, to a large degree, do not respect political boundaries, they are too often major barriers to research designed to shed insight on recreation within the Lake Michigan basin. Since this problem is political in nature, the solution too must come from within our political systems. Conferences, such as this, can provide the stimulus needed to solve this kind of problem.

Recreation and the Lake

Let me now turn to my central theme -- recreational use and development on and around the Great Lakes and, in particular, Lake Michigan.

While the data are less than complete, there is ample evidence that Lake Michigan is a premiere recreation resource. People pursue recreation near, on, in, above and under Lake Michigan. People are drawn to the lakeshore to frolic in the sand, picnic, collect rocks, enjoy the scenery and just to spend a quiet moment communing with nature. Many thousands spend at least part of their vacations or weekends in second homes, condos, campgrounds and a wide range of rental units located on the lakeshore. Some even use the deception of claiming to boat in order to acquire a getaway in close proximity to the Lake. In- or on-the-Lake recreation is equally diverse. Swimming, wading, sailing, power boating and wind surfing are all popular, and there are some Lake recreations that defy simple description. Under-the-Lake recreation has become feasible with development of scuba gear, and drysuits and wetsuits help combat the cold temperatures of the Lake. Michigan recently created its fourth underwater preserve to protect underwater resources for the scuba diver and eventually, we hope, for the non-diving public as well. Flying over the Lake in small planes and hang gliding are examples of popular over-the-Lake forms of recreation. We are even beginning to see renewal of interest in lake cruises that once brought many thousands of Chicago residents to resorts along Lake Michigan. Today's Lake Michigan cruises, unlike those taken before the era of the automobile, are primarily short day-trips taken strictly for pleasure rather than as a means of transport.

Probably the most exciting activity on the Lake is also one of the oldest -- recreational or sport fishing. After years of neglect and abuse, the

recreational fishery in Lake Michigan is back. Salmon mania is near its annual peak. Introduction of salmon in the Great Lakes ranks among one of this region's most outstanding recreation success stories. Not only do salmon hold a special attraction for the sport angler, they have also controlled bait fish populations that used to periodically litter our beaches.

The salmon story is useful to illustrate an important general principle underlying recreation and the Lake. In general, any program which benefits the environment of the Lake enhances its recreational potential as well. Hence, reducing pollution levels, controlling shoreline erosion and resisting water diversion programs are all, in a real sense, recreation programs.

Before turning to a brief review of the statistics we found concerning recreation and Lake Michigan, I would like to bring a related and major concern to your attention.

Only 1,200 miles of the 21,700 miles of combined ocean and Great Lakes shoreline in the continental United States is available for public recreation (CENR, 1978). Given that the projected 1 to 2 percent growth in water-based recreation participation that recreation planners are forecasting through the year 2000 (Cordell, et al., 1985) is realized (and history has proven past recreation forecasts to be too low), this small percentage of shoreline will become increasingly overcrowded. We simply cannot allow even small chunks of it to disappear from the public estate. However, we must also do more than we are doing now to manage our shoreline.

We should develop a portion of this shoreline to accommodate more public use in a manner that both protects the environment and minimizes conflicts among users. As we plan, we must be concerned with all aspects of the recreation access problems including: (1) the public's right to enter, (2) the public's ability to travel to sites open to them, and (3) the availability of on-site facilities ranging from roads to restrooms. All three of these conditions must be present for our remaining shoreline to be truly accessible to the public.

Selected Lake Michigan Recreation Statistics

It was difficult to find any single measure of the overall attractiveness or value of Lake Michigan as a recreation resource. However, the research results of a MSU colleague, Dr. Joe Fridgen, can be turned to this end. He recently surveyed travelers along Michigan's major highways asking them to select those Michigan counties which they considered as the best for tourism (Fridgen, 1985a). Five of the six top-ranked counties are adjacent to Lake Michigan. Only one of the top ten is an inland county, Roscommon, and that county contains Michigan's largest inland lakes. The ranking of Detroit's Wayne County among the top ten is probably linked to many attractions beyond its location on the Great Lakes.

Clearly, recreation and tourism in Michigan are strongly tied to its Great Lakes, and Lake Michigan in particular. Yet another indicator of the

attraction the Lakes have for recreationists is also provided from another of Joe Fridgen's research projects involving Michigan's State Parks.

Over the decade from 1970 to 1980, the use of Michigan's State Parks across the system increased by only 1.5 percent, while coastal parks in the system registered a 15.5 percent increase (Fridgen, 1985b). While overall attendance actually declined by 2.5 percent between 1980 and 1983, coastal parks registered over a 7 percent increase. Nearly half of all State Park visitation now occurs at coastal parks.

Turning to specific activities, let's focus for a moment on recreational boating. Nationally, nearly 70 million people participated in boating in 1984 (Rounds, 1985). In that same year, retail boat sales topped $12 billion and over 13 million boats were in use (Rounds, 1985). Over 600,000 of these were registered in Michigan. In 1982, we (Stynes, et al., 1982) surveyed a sample of these boaters to assess how much they spend on the full range of products and services they purchase on boating trips. We were surprised, in fact amazed, to learn that they spent a total of nearly $1 billion in a year that was one of the poorest in recent history for boat sales and the economy in general. Approximately 40 percent of this spending involed Great Lakes boat trips. Further extrapolation suggests that about $200 million of spending was linked to recreational boating on Lake Michigan. Since we were unable to survey boaters who trailered craft from out-of-state, actual boating spending in Michigan was considerably higher. Had we repeated this study in 1985, I would project boater expenditures would be up by about 50 percent based on booming boat sales and use. Finally, overall impact on the Michigan economy would, of course, be considerably more since this $1 billion in direct spending recycles through the economy, producing what economists refer to as a multiplier effect. The vitality of Lake Michigan's boating industry is also evident in the growth of marinas along the Michigan portion of the Lake's shoreline. A former research assistant, Gene Brothers, took aerial photographs of these marinas in 1983 and compared these photos to ones taken in 1978. The change is striking. Nearly 2,300 new slips were counted (Brothers and Holecek, 1983). This represents a 30 percent increase over the five-year period. While the counties bordering Detroit added the most slips, the growth in northwest Michigan was almost 50 percent. Yet, spot checks of marinas all over the Lake suggest even this rapid growth in facilities is lagging behind demand.

Fishing also is an activity linked to the Lakes. It is both economically important and experiencing rapid growth. In 1985, resident fishing license sales increased by nearly 30 percent in Michigan, and trout and salmon stamp sales were up over 15 percent (Opre, 1985). Surprisingly, daily license sales (most often purchased by tourists) were up over 50 percent. The Lake Michigan sport fishery is the largest in the Great Lakes. Anglers spent an estimated $250 million in 1980 in pursuit of Lake Michigan sport fish (Marine Advisory Service, 1985). In 1981, in Michigan waters of Lake Michigan, nearly 375,000 anglers spent 4 million days fishing (MDNR, 1981). Recreational fishing is an important use of Lake Michigan, and it appears to be growing very rapidly.

The last use of the Lake Michigan shore that I want to mention is for second homes. Michigan continues to rank near the top among the states in terms of the second homes it provides. About 25 percent (54,000) of Michigan's second homes are located in the coastal counties along Lake Michigan. The 20-year trend was generally rising for second home development along the Lake Michigan coastline. There are both positive and negative aspects to this growth. On the plus side, the homes are generally high quality. On the minus side, we have lost a few more miles of undeveloped coastline.

Concluding Comments

While the statistics available are far from adequate, there can be little doubt that Lake Michigan is an important recreation resource and, quite probably, the most important single resource in the upper midwest. Recreationists and tourists are significant contributors to this region's economies, especially to some northern communities along the Lake. Beyond the obvious economics of this industry, it also is a factor in the region's overall quality of life, a quality which GM and other firms are weighing more and more heavily in locating their plants. Finally, I want to respond to the central theme of this session: "Environmental Protection and Economic Development: Is Synergy Possible?" with a very definite yes. Indeed, both are essential to a viable Lake Michigan recreation and tourism industry. The trick, of course, is to marshal the information and expertise needed to minimize areas of incompatibility between these potentially complementary goals.

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MOVING GOVERNMENT GOODS ON THE GREAT LAKES--WHAT AN INCREASE WOULD MEAN IN JOBS AND DOLLARS FOR THE REGION

DONNA WISE, PRESIDENT
THE CENTER FOR THE GREAT LAKES

I'm pleased to be here representing The Center for the Great Lakes and to share with you the preliminary findings of a report we will be releasing in November.

You heard yesterday about a number of Great Lakes water quality and quantity problems with which we all have reason to be concerned. The Center for the Great Lakes, a not-for-profit, binational and impartial institution, is concerned with these issues as well. We are working to assure that the quality of Great Lakes water is maintained and enhanced through actions of public and private decision makers. And we are concerned that a coordinated regional water management framework be developed that will assure our region of an adequate supply of Great Lakes water to meet our current and future needs. But The Center also views the Great Lakes, if carefully protected, as a strong regional asset that can provide significant economic benefits to the region.

To put our new study in context, I'd like to present some background information on the St. Lawrence Seaway. Its opening in 1959 added an important new international dimension to an already established intralake shipping trade. It provided for the first time a direct link to ports in Europe, the Middle East and Africa. Direct and indirect benefits of overseas shipping via this route are estimated as some $3 billion a year to the U.S. and Canadian economies.

However, while the U.S. Army Corps of Engineers estimates the Seaway capacity at 80 million metric tons a year, the Seaway in its best year so far -- 1977 -- handled little more than 70 percent of its capacity. In many years, it has handled a lot less.

A number of reasons have been cited to explain why the Seaway hasn't reached this capacity. Among them are:

- pilotage fees and Seaway tolls which result in high operating costs;
- the size of the locks, which exclude larger vessels which call on tidewater ports from entering the system;
- a lack of U.S. flag carriers on the lakes, a problem in the face of restrictions stipulated by federal laws and policies;
- a perceived lack of predictable and reliable cargos which would be an inducement for more ships to enter the system.

As Jim Emery pointed out yesterday, the government and private sector are working cooperatively to resolve many of these issues. However, our region's leaders continue to ask why jeeps and other vehicles made in Michigan are

being shipped overseas from the Port of Baltimore. Why are goods in this region bringing dollars and jobs to Maryland's economy instead of to ours? What would it mean if these shipments left from Great Lakes ports?

The Center has been working with the assistance of COMMUNICORE, a Chicago-based firm with expertise in Great Lakes shipping issues, to evaluate, first, whether or not we have a reliable source of cargo to serve as an inducement for more ships (particularly U.S. flag ships) to come into the system, and secondly, if we do, what would increased overseas shipments through Great Lakes ports mean in terms of jobs and revenue to the region.

The Center's report, "Moving Government Goods on the Great Lakes: What an Increase Would Mean in Dollars and Jobs to the Region," will be released in a few weeks. Meanwhile, I will try to give you a thumbnail sketch of our findings.

The Center has undertaken an analysis of (1) what is produced in the region; (2) where these goods are currently being shipped from; and (3) what impact would occur if more of these goods moved by way of the Great Lakes/St. Lawrence Seaway system.

We focused on government goods because (1) the data was available in the form we needed for analysis; (2) the eight Great Lakes ports examined had records of shipping such cargo previously; and (3) it was assumed that a large portion of government-purchased goods originated here.

The specific kinds of government goods examined included military equipment purchased for our own troops' use or for sale to other governments; military household goods and purchases by U.S. military personnel for transport between U.S. and overseas bases; and food commodities, particularly those used to provide famine relief.

The area included in the study included the eight states bordering on the Great Lakes and also five adjacent states which depend on Great Lakes shipping: North and South Dakota, Iowa, Kansas and Nebraska.

We found that:

- sizeable quantities of these goods are generated in the eight Great Lakes states and five adjacent states;

- only a small fraction of these goods destined for overseas locations in Europe, the Middle East and Africa are actually shipped from ports in the Great Lakes states; and

- were Great Lakes ports to handle a greater share of these goods, the region would see sizeable increases in jobs and revenues.

For instance, our findings indicated the following:

- If 50 percent of the goods grown or manufactured in this region and purchased by the U.S. government were transported overseas by way of the Great Lakes and Seaway, 3,779 jobs would be created and $83.5

million would be generated for the region's economy. At least 1,100 of these jobs and $27.3 million of the money would go directly to the longshoremen who load and unload cargo at Great Lakes Ports.

- Information provided by steamship agents also revealed that an average of $230,000 is spent on direct expenses every time a vessel loads between 5,000 to 10,000 tons of cargo at a Great Lakes port. If additional government cargo produced one additional sailing per month from each of eight major Great Lakes ports, the impact would total $16.6 million a year.

In addition, the study revealed that in 1984, for instance, 7.8 million measurement tons of U.S. Defense Department cargo moved by ship to and from the four U.S. coasts (Atlantic, Pacific, Gulf and Great Lakes). Yet, Great Lakes ports' share of this cargo was less than two-hundredths of a percent.

In 1984, the household goods of military personnel made up 13 percent of all U.S. Defense Department cargo moving from the East Coast to overseas ports. Almost none of these goods moved through the Great Lakes even though approximately 14 percent of the nation's military personnel were stationed within the 13-state study area.

Between 1979 and 1984, an average of 5.2 million metric tons of government-sponsored food assistance cargo were shipped from U.S. ports each year. However, only 5 percent of the total moved through Great Lakes ports, even though the 13-state study area accounted for 41 percent of the value of all U.S. agricultural exports.

One of the reasons for the small Great Lakes share of this cargo in recent years has been, as I noted earlier, the lack of U.S. flag carriers in the lakes. There are currently two such carriers; until a few months ago there was only one. That situation may be changing, though. FedNav Lake Services, this year's new U.S. carrier, hopes to have a second ship in the lakes next year. One of the major incentives for bringing that shipping line into the Great Lakes, we've been told, was the potential for U.S. government cargo shipments. So far, that potential has been borne out. The Port of Toledo estimated that a single shipment generated $630,000 for its local economy. The first four FedNav shipments generated $1.4 million.

The Center's study will show for each port, and region-wide, what such increases will mean in jobs and revenues for our region, as well as what it could mean in terms of more effective use of a unique regional transportation system.

Thank you again for giving me the opportunity to speak to you. I'm pleased that so many of you are here, and I know that you share the concerns we at the Center have for an enhanced appreciation for the Great Lakes. I hope this concern will be translated in the years to come to a sustained commitment to protection of this valuable economic and environmental resource.

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USING COASTAL ZONE MANAGEMENT TO ADDRESS LAKEFRONT PROBLEMS THROUGH STATE POLICY DEVELOPMENT

WILLIAM J. BRAH, MANAGER
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State coastal management programs nationwide are well into the implementation phase and are achieving results. In the Great Lakes region, coastal management has played a significant role since 1977 when Wisconsin and Michigan completed their programs. Many view the national coastal management program as a model for a wide range of other resource management initiatives where state leadership is needed.

In order to explain Wisconsin's approach to coastal management, this paper reviews the program's development history, describes its organizational structure, and provides two examples that demonstrate how we have addressed coastal problems. One example shows how we focused statewide attention on improving the condition of our urban port areas. The other example shows how we addressed the issue of water diversion from regional perspective. These cases are then analyzed in order to show why better management was achieved.

Wisconsin started looking at how to improve management of the Great Lakes early in the 1970s because their special management needs were not recognized adequately in the thinking of our citizens and state institutions. Lakes Michigan and Superior were just two of 10,000 lakes. Wisconsin was recognized nationally as a leader in resource management, being one of the first states to adopt comprehensive shoreland protection and floodplain management programs, for example. These and other resource management programs worked well. But they were applied statewide and did not assign a high enough priority to the management needs of the Great Lakes.

The efforts of Wisconsin and other states to improve management were boosted significantly in 1972 when a voluntary national coastal management program was established. The Federal Coastal Act says that the key to better management is for the states to exercise their full authority and leadership in cooperation with local and federal agencies. The national program provides federal funds to states to support coastal management if they meet this requirement for increased state leadership.

What kind of additional management effort directed at the Great Lakes was needed in Wisconsin? This question was posed to our citizens at over 50 meetings held in communities along our 820 mile coastline. From these meetings came overwhelming support for improved management. The citizens made it clear that they wanted existing state programs to work better.

Wisconsin developed a program that focuses on improving the existing state management system while studying the need for longer-term reforms. The Department of Administration was the logical state agency to take the lead because of its broad perspective and responsibilities. The Department is an executive agency which acts as the Governor's chief policy advisor and financial manager in preparing the state budget. It analyzes policy issues

faced by the state and recommends solutions. And it is responsible for initiating and coordinating statewide planning efforts concerning natural, energy and human resources.

A Coastal Management Council was also created. Comprised of the state agency directors and public and local government representatives, the Council provides to the Department and Governor a broad perspective on Great Lakes issues. All of the state agencies agreed to use the Council as their advisory body when considering policy questions concerning the Great Lakes.

This new organizational arrangement facilitates the coordination of the governmental programs affecting the coast; provides a single, strong voice to advocate better management; and enables problems to be looked at comprehensively and systematically. The following examples show how this works and what is being achieved.

Our major Great Lakes ports are an important statewide asset. But their economic prospects were on a rollercoaster ride when we started to look into their condition. They prospered until the 1960s, when they began to decline because of competition with other ports in the region, the economic recession and national economic policies. At the same time, there was a growing water based recreational industry in the state and steadily increasing demand for marina space. This was an opportunity that could be captured by the ports if they could recognize and plan for it.

Unfortunately, the state viewed ports strictly as a local concern. State transportation planning virtually ignored their special needs. Communication among the port directors was limited. Few of the ports had plans to maintain themselves, guide new development or better use existing facilities. They were having a difficult time finding sites to put dredged materials. Finally, the ports were competing with each other for scarce federal navigation and dredging dollars. The federal policy of increased local cost sharing put more pressure on them.

Our policy development efforts focused on raising port operations to a state level concern, and improving the ports' capability for planning and maintenance. We did this by studying the importance of Great Lakes ports, examining recreational and commercial harbor trends, sponsoring conferences, providing demonstration planning grants to the ports, and lobbying. Here's what has been accomplished.

The Wisconsin Council of Great Lakes Ports was created to improve communication, organization and the political clout of the ports.

In the budget development process, a program was created to provide grants for commercial harbor improvement projects. The Harbor Assistance Program, administered by our Department of Transportation, funds repair and maintenance of docks, dredging and development of new facilities.

A program also was enacted to perform a similar function for recreational harbors. These grants are provided by the Waterways Commission. Now, all ports, whether small or large, commercial or recreational, have some state financial aid available to them.

The harbor plans, marketing strategies, feasibility studies and capital improvements funded under these and other programs have resulted in new harbor facilities either completed or in process in Racine, Ashland, Manitowoc, Port Washington and Washburn. All are geared to the growing recreational industry.

We also made a concerted effort to help the ports find environmentally acceptable and economical ways to dispose of dredged material. The lack of state assistance in this area was glaring. There was little advanced planning for disposal sites and there were few obvious sites. It took years to get through the permit process. A harbor-by-harbor analysis of siting problems and dredging needs was conducted. Grants were provided to the ports for plans concerning long-term harbor maintenance.

This effort has resulted in the Department of Natural Resources making the improvement of the Great Lakes dredging process one of its highest priorities this year. Legislation will be introduced to set up planning process whereby harbor plans can lead to state general permits for a ten year period for maintenance dredging, based on planned new improvements and beneficial use of dredged material. This is an alternative to the ports to getting permits every year or so before dredging begins. Perhaps the most important feature of the bill is the commitment made by the state to provide an organized, systematic program of technical assistance to the ports.

We are making an effort now to get the federal agencies involved in the planning process so that the harbor plans satisfy their regulatory criteria. We are funding several of the larger port plans in order to demonstrate how the new planning process works. To improve the quality of seashore waters in the port cities, and complement our massive investment in sewage treatment, we are trying to focus our statewide non-point source pollution abatement program on the Great Lakes watersheds in the major urban areas. When the watershed plans are done, state funds are available to landowners to install non-point pollution abatement devices. We got state legislation passed to make the Milwaukee area, a city with great potential for riverfront and lakeshore recreational development, a priority for this program.

We are also concerned about the competitive position of the region's port cities with those of other regions of the nation. We see great opportunity to make Wisconsin more competitive in the context of the federal water resource cost-sharing policy being developed at the federal level. Under this proposal, the local beneficiary of federal projects such as navigation, water and power supply, would provide an increased share of a project's cost.

We already share the cost of Great Lakes navigation projects, for example, through tolls. But our return in the form of federal project dollars is 40 percent below that of the rapidly growing western and southwestern regions of the nation. Beneficiaries of federal projects in these areas have been allowed to escape cost sharing. For example, because of massive federal subsidies, water rates in arid states like Texas are lower than in some cities in Wisconsin, and we are next to the world's largest supply of freshwater. Also, there are more recreational boats per capita in Arizona than in any other state.

These distortions resulting from federal subsidies have contributed to depriving Wisconsin and other Great Lakes states of our natural advantage in this critical water resource. We are actually subsidizing development in other regions and are being asked to increase this subsidy through greater cost sharing. We support the cost-sharing policy therefore if cost sharing is applied comprehensively nationwide. This would tend to even out the subsidies and allow the regions to compete on a fair basis. We are pushing this concept actively and aiming at the gaping holes that are emerging in the federal cost sharing legislation now being considered.

Finally, we are currently developing ways to emphasize in state spending and investment decisions the need to encourage economic expansion in established Great Lakes urban areas. We find that the dispersion of population and jobs to undeveloped areas on the urban fringes puts added pressure on open space, prime farmland and wildlife habitat, and creates costs for new state services such as highways, wastewater treatment, etc. These trends are long standing, but state public policies and expenditures have often acted as catalysts in furthering them. On the positive side, these can plan a pivotal role in stimulating larger economic initiatives in the cities, such as redeveloping underused or deteriorated coastal waterfronts and harbors.

Water Diversion

Wisconsin shares the Great Lakes resource with other states in the region, and the need for cooperative regional resource management initiatives is becoming more important.

Wisconsin and other states in the region were quick to recognize a number of emerging trends that pointed to increasing pressure on Great Lakes water. The explosive growth of major population centers in the southwest and the steady expansion of irrigated agriculture in the west were acknowledged as long-term threats. But the event that had an immediate effect on the recognition of potential interbasin diversions was a plan in 1981 for transporting coal from the Powder River Basin in Wyoming to the Great Lakes via a coal slurry pipeline. One option involved transporting Lake Superior water to Wyoming to be used in the production of the coal slurry by way of a second pipeline.

We recognized the necessity of developing a long-term regional strategy rather than reacting to future large scale diversion projects where we would have to accept compromises. This would involve working cooperatively with the other states and provinces in the region to find a way to strengthen our institutional capacity to deal effectively with the threats to our water.

In response to the Powder River proposal, we joined with the other affected states in the region to spearhead a successful effort to derail federal legislation that would have made it much easier for coal slurry pipeline companies to purchase rights-of-ways to build pipelines.

We organized an international conference in 1982 in Milwaukee, in which 25 experts from the United States and Canada addressed the prospects of diversion of water out of the region. In addition to publicizing the issue, this

event underscored the fact that we lacked the laws, institutions and information necessary to make effective decisions regarding interbasin transfers of water.

Shortly after the conference, the Governors and Premiers of several Great Lakes states and provinces held a water summit in Michigan. They resolved that any future diversions of Great Lakes water for use outside of the region would not be allowed without the concurrence of all of the states and provinces in the region and their respective federal governments. This was a very visible show of concern and unity, but lacked a basis for implementation.

The need for stronger regional cooperation on the water diversion issue was one reason why the governors in the region decided later in 1982 to create the Council of Great Lakes Governors to work cooperatively on common public policy issues. Because it is comprised of the chief executives, the Council could generate political and policy consensus on key regional issues and get support within state government.

We had the opportunity with Wisconsin being the first chair of the Council to suggest an agenda. The Council appointed in 1983 an interstate task force to evaluate and recommend institutional mechanisms to strenghten the ability of the Great Lakes states to resist or regulate diversions of water out of the region. Wisconsin was the chair of this task force, and turned to the coastal program for staff support.

The institutional strategy that was recommended by the task force was somewhat broader and different than that anticipated in the Governor's directive. The fact that the demand for water in the region alone was expected to double in 15 years dictated that the strategy address consumptive use and interbasin diversion of water within the region. Because federal court cases suggested that states may regulate and under certain conditions, even prohibit interbasin diversions, but they may not impose outright bans on interstate water transfers, or the strategy had to treat in a evenhanded way both in-state and out-of-state users of Great Lakes water. Finally, it was recognized that the strategy had to be based on state initiative. Federal support for Great Lakes protection would be more likely if it could come in the form of recognition of a regional water resource management program put together by the states in the region.

The task force therefore recommended a watershed management approach that applies to use of the water within and outside of the region; enactment of legislation by each state, where necessary, to regulate water use; consultation within the region to seek consent before approving any major new or increased diversions or consumptive uses; and a program aimed at providing better information on water use for future water management decisions.

These recommendations were incorporated into the Great Lakes Charter signed in 1985 in Milwaukee by the Governors and Premiers. The Charter is a milestone in the region's history. For the first time, the chief executives of the region agreed to a series of steps leading to a regional water resource management program.

Wisconsin's work was cut out for it because unlike some other states, we needed major state legislation to fulfill the promise made in the Charter. The coastal program took the lead in drafting a water diversion bill in cooperation with our Department of Natural Resources and state legislators. The bill was one of the top priorities for the 1985 fall special legislative session on economic development.

The enacted law applies statewide and governs the interbasin transfer and consumptive use of all water of the state. It incorporates all of the standards for water use regulation established in the Charter into existing regulatory programs administered by the state. And it requires the preparation of a state water resource management plan. Finally, it tells the coastal program to use the standards in the bill to review proposals for water diversion that need federal permits under the provisions of the program that require federal agencies to comply with the policies in our coastal management program.

The bill puts us in the drivers seat concerning diversion proposals originating in other states or by private companies. Because it would be overcome by a federally authorized and financed project to pipe Great Lakes water out of the region, we continue to promote the kind of regional cooperation and commitment that is necessary for recognition of our effort at the national level.

Why Our Approach Works

Although Wisconsin's institutional setting is different than those in other Great Lakes states, there are elements of our approach to coastal management that may be useful to those intersected in coastal management in the region.

First, we look at Great Lakes problems comprehensively. Our ports strategy is an example of how many facets of the problem, ranging from finding sites for disposal of dredged material to influencing national policies affecting the competitive position of the ports, are addressed.

Second, our perspective is long-term. In the water diversion case, our strategy addresses a future scenario now to put us in the best possible position.

Third, the two examples discussed show how we focus on issues of statewide and regional concern which cut across a number of agencies. The coordination role we play complements and strengthens the programs of other state or local agencies.

Fourth, we have the means to carry-out our mandate. Our position in an executive agency which has a history of strong working relationships with the line agencies enables us to effectively carry-out our policy analysis responsibility.

Finally, we act as a catalyst to get new management initiatives started. Rather than duplicate or share the functions of the other state agencies, we strengthen their capabilities by funding staff positions and studies that spur new initiatives.

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QUESTIONS AND ANSWERS

WATER AND LAND USE AND DEVELOPMENT

Question: Why are water bills more expensive here, where we have an abundance of water, than they are in states with no water?

Answer: The water is more expensive to drink here simply because we as taxpayers spend more money on our own drinking water system to maintain them. That's state tax dollars. However, for example, in the Southwest part of the country or in the West there's such a heavy federal subsidy of water supply projects that the federal government, which means all of us everywhere, ends up paying part of the cost of that water so that the user actually just sees the cost that they pay so it's many cents less.

Question: There were some 600,000 boats registered in the State of Michigan. Do we have any figures about others coming in from other states.

Answer: The only thing we know with some degree of certainty is how many people reside out of state and register their boats in Michigan. In terms of how many people trailer their boats in, things like that we haven't been able to do enough research to assess that. It might be useful to make this point with respect to recreation and travel and tourism; we have very good information about corn production, steel production, etc., but questions like this we find very difficult to answer.

Question: Relative to these 600,000 boats, do you have any information related to the ownership of those boats whether it retains within the State of Michigan or whether it's from neighboring states? Not so much the trailerable boats, but the boats that are maintained within the State of Michigan?

Answer: We do have some data in our files, but right off the top of my head I don't know the specifics on it. Port by port, marina by marina there's quite a lot of variation. Some marinas are dominated by boaters from Illinois for example.

Question: I'm with the National Marine Manufacturers Association. Two things that the people here ought to know: First, that we do have state by state registration breakdowns if anybody wants to know it, by length, by type, not necessarily by where they're specifically berthed, which is the second piece of information that is coming up. We are currently involved with Sea Grant and with the U.S. Forest Service in the first national inventory of boating facilities, state by state, county by county. The first runs are coming off the computer in Rhode Island probably in October of 1985. If you will make a note of that in your notes to contact me along about the first of the year we should be able to provide anybody here with a county by county count of boating facilities. That will be expanded next year into a slip count per se. At the

same time, in response to trailering, we are doing a survey of trailer owners to determine how far they typically trailer their boats to enjoy the sport that they have committed to. Thank you.

Question: I have a comment and a question for Congressman Visclosky. I think that your Marquette Project is an exciting innovative concept that can really serve the future economic development in northwest Indiana. What kind of response, if any, have you received so far from some of the major industries in northwest Indiana, particularly with the concept of some public access to the lakefront along those areas that are now totally controlled by industry and the proposed lakefront drive?

Answer: CONGRESSMAN PETER VISCLOSKY, Indiana

They've not been real hot about the idea. The hesitation has not been on management's part, although they have been very cautious in their response. The real hesitation is with the labor side. The perception is here is a fellow that never worked in the mill, went to college and wants a beach out there. That is obviously not what we want to do. We want to have a nice compatible mix again from Illinois up to Michigan. So at this point I would say reactions are still mixed. You have a pattern that has developed in northwest Indiana with the oil industry and the steel industry that's well embedded after almost 80 years. That is just not going to change overnight.

One other comment. I found it interesting that Mr. Ranney said one of their major issues with the union at the coke oven, was fishing at the plant during off hours. I think the unions and the public believe some of the best fishing is in fact at the steel mills. Maybe we can all work together to achieve more public access. Thank you.

Question: You emphasized economic growth as a major objective of the Center for the Great Lakes. One of the exciting things that we have found out in this two day conference is a large increase in the attention being paid to scientific research. Please comment a bit on what emphasis the center is placing on science for its future plans.

Answer: DONNA WISE, President, Center for the Great Lakes

One of the major priorities of the Center is to assure maintenance of water quality and enhancement of water quality. Thought was given to the extensive amount of research and the very valuable research that is produced in this region when we were first established. Basically it was felt that oftentimes the research that is available, isn't in a form that is usable by decision makers. I see the center not as gearing itself solely toward scientific research but more as a interpreter of that research, taking the excellent, valuable research that exists, synthesizing

it, analyzing it and translating it into a language and a format which is actually usable by our decision makers both in the public and private sector. Does that answer your question?

Question: Well, it's a little disappointing. I would think you would want to add to the stockpile of information from your own particular point of view. It's great that you're using existing material that is being gathered by others, but you know it would be more encouraging if you had some slant of your own.

Answer: We are not doing independent research in the area of water quality which I thought your question was addressed to. The work that has just been done on the shipping project which I discussed is absolutely original research. The data has never been collected. It has never been viewed before. That information is original research where we see a need, where someone else is not conducting research on a given subject and we think it's useful then we will have that research conducted for us. We will be using consultants. We are doing legal research right now with respect to diversion and the Great Lakes Charter. We have legal experts commissioned and are working in Canada and the U.S. to evaluate our current legal framework. Is it sufficient to protect the region as a whole or put the region in good standing to protect its water resources. And if not, legally what options do we have at the state, provincial, federal and international levels? Again, that research has never been conducted before. There have been some new court cases that have turned the world upside down and we have to sort of start from scratch. So we do have independent research and new research being conducted in that area. I was just referring to water quality. At the moment we are not conducting any independent research there.

Question: There has been an allocation of tax revenues from the boating and fishing public to sport fishing enhancements and boating enhancement and access. That has currently been stalled and is just sitting there. Also, it has been cut in half in terms of potential appropriation. Would you care to comment please on: (1) what the prospects for getting the full funding available, and (2) how we as the constituents can assure that that funding is made available to the fishermen and boaters in this region?

A second question if I may just quickly? Could you please help us identify those states that have a firmly established policy for water dependent use activities at the waterfront, rather than non-water dependent use? I think it's critical to state's policies and the development of the waterfront for the public to have those policies in place. I fear that many states do not.

Answer: CONGRESSMAN PETER VISCLOSKY, Indiana

The first thing that I would suggest is that you write your member of Congress. Also give calls to those members of Congress to find out what the projection is, as to whether or not you're going to

get full funding, I would say don't hold your breath. The problem in this country today is that the federal deficit tomorrow will be $584 million more than it is at this very moment. You have two essential problems that were not addressed in this Congress. I assume because of the election next year they will not be addressed. Therefore, all those discretionary types of programs, where you have some annual leeway as far as whether you're going to spend the monies or not, are going to go by the boards. The first is the defense budget, and I am as upset with members of my own party as I am with the others as far as their inability to control that after seven years of real growth. It is not making us any more safe, and again the failure of both political parties and both Houses of Congress and this Administration to come to grips with over 90-odd entitlement programs, some of which are smaller as far as number of participants in a country of 230 million people than the number of people who sit in this room. There is one with less than 30 people participating in it. There's another called Social Security with 36 million people participating in it. Until you begin to bring those two areas of the budget under control there is no money left. You're talking about boating and recreation, I'm talking about people dying, I'm talking about in Lake County, Indiana, nobody eating. In Gary, Indiana, and in Calumet Township, I'm talking about people going without health care. So I would say again, and I'm not being mean, don't hold your breath for some of these dollars.

Address. BILL BRAH, Manager, Wisconsin Coastal Zone Management Program

I'll address the water dependent question. As far as I know, every state that has a coastal program gives priority to water dependent activities on its coast. What does that really mean? I guess my answer to your question is that it means something different in every state. I'm most familiar with the efforts of Seattle, Washington; San Francisco, California; and Juno, Alaska that are now going through that issue. What does it mean with regard to our particular shoreline? It's a function of how much other space is available, and the economic trends in the area. San Francisco includes an airport as being a water dependent use. It would be unthinkable in Seattle, yet both have priorities for water dependent use. I can't speak to the programs in this region because I'm not as familiar with them as I am those in the other parts of the country.

Any further comments from the panelists?

DR. DONALD HOLECEK, Professor and Director, Michigan Travel, Tourism and Recreational Resources Center

I guess I just have one quick comment. Governor Orr indicated some concern about service industry jobs as opposed to steel, automobile, and basic industry jobs, and the idea that we need a mix was brought out by Mr. Ranney. Just a couple of facts and figures that come to mind. In the year, 1981 or 1982, 50 percent

of all new jobs created in this country were created by the travel industry. Today, something like 10 percent of all the jobs in the United States are within the travel industry. Most of the reports most of us have seen indicate that the job growth in the future is in the service industries. I agree with you I have to find a balance but my particular bias is that we haven't spent very much time, economic planners among us, thinking about the potential for capitalizing on the growth of jobs in the service industry as we might find linked to Lake Michigan through recreation, travel and tourism.

CONGRESSMAN PETER VISCLOSKY, Indiana

If I could add a comment to that. The people at the Business and Economic School at Indiana University addressed the Indiana congressional delegation several months ago. Their prediction by the end of the century is that the manufacturing sector will only employ about 11 percent of our working force as opposed to 20 percent today. Now we can imply by those numbers that that is bad, but it's not to indicate that you will have less goods produced in the United States. It simply means that we will have become more efficient in that area. It does mean certainly for areas like northwest Indiana and other industrial areas in the states participating in this conference, that over the near term you're going to continue to lose employment in that sector. To discount the service sector, in return for going back to the past, is going to be a mistake. I think there's an incremental move to look at steel, and look at how you can make other types of metal equipment and implements geared to those jobs of the future. Some of the areas of true growth are medical research and technology, the delivery of health care. Maybe there's new instrumentation, new test equipment and those types of things where we can take that first step towards those new areas where you are going to have real growth in employment. To do that very well in the Midwest you have great institutions in Michigan and Illinois, and if I recall in Illinois you added a Scientific American edition in September of '81 where they advertised Purdue University as well. So I think we all share something in common.

Question: I would like to have your opinion, Congressman, on the CDFs that they do have quite a few of on Lake Michigan now. What would be your suggestions the alternative as to putting toxics in the CDFs. Do we have some alternative or is our government working on something in this manner?

Answer: It's a serious problem if you're talking about contained disposal sites in the lake and certainly in our neck of the woods, it's a very hot topic at this point in time. There is a proposal pending at this point to take the dredgings of Indiana Harbor, which were mentioned earlier in the morning and create an island in East Chicago, Indiana. You would solve two problems. You would assist commerce by dredging, you would contain the materials, and you would create a harbor for other potential economic purposes.

Obviously, there is a controversy regrading that proposal and many in the environmental community suggest that it would be unsafe. My question to many of those members is: Where do you put it? When you point to landsite A they say, "No, you can't put it there." You point to landsite B and they say, "No, you can't put it there." Then there was a proposal, not necessarily to incinerate those particular substances, but other types of hazardous materials in Hammond, Indiana that neighbors East Chicago. Well, the winds blow over East Chicago, and when I happen to go door to door in the neighborhood next to the incineration facility, literally every other household that I visited said, "No, you can't burn it here." Well you can't put it on the moon! My message to all of the citizens who were concerned is know that two questions must be answered. One is the transportation issue that's involved, and the other is the ultimate disposal issue. In order to protect your interests, go to these groups--the Sierra Club, the Isaac Walton League--who have the expertise and who have the people, whether it's in Indianapolis, Springfield, or other state capitols, and also Washington. But do it with another question in mind. Don't let them just say no, but come up with a viable alternative proposal, because the situation as it exists today is also not safe. Over and above that in our situation in northwest Indiana, we are literally desperate to create jobs. If you find a reasonable alternative you still leave myself and other officials with the problem of how are we going to develop all of these wonderful marinas and harbors. Where is the substance for that and where is it in the foreseeable future? As far as a direct response, I don't know if there's any perfect solution. I tend to doubt it. We have to find the best practical solution, and we ought to pursue it as soon as possible.

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LUNCHEON ADDRESS

WILLIAM J. SCOTT

FORMER ILLINOIS ATTORNEY GENERAL

William J. Scott is the only person to be elected four times as Attorney General of Illinois. Mr. Scott took office in January, 1969, and was reelected to his second term by the largest vote plurality of any state candidate in the nation, 1.2 million votes. He was reelected to an unprecedented third term in 1976 by a 1.1 million vote plurality, and to a historic fourth term in 1978 by his greatest percentage of approval, 65.3 percent of the vote.

In 1978, Scott was named the outstanding state attorney general in the nation, and he was presented the Wyman Memorial Award by the National Association of Attorneys General.

Scott won international acclaim for his legal battles against pollution of the environment. The governments of Italy, Greece, Israel and Japan have consulted him regarding their pollution problems. President Richard M. Nixon named him to represent the United States in the 1972 United Nations Conference on the Human Environment in Stockholm, Sweden. The National Association of Attorneys General recognized his leadership by naming him chairman of the groups's first Environmental Protection Committee in 1969.

Scott graduated from Chicago-Kent College of Law in 1950 and was admitted to practice before the Illinois Supreme Court the same year.

Scott is currently counsel to the law firm of Burditt, Bowles & Radzius, Ltd.

LAKE MICHIGAN - THE CHALLENGE TO OUR LEGAL SYSTEM

WILLIAM J. SCOTT
FORMER ILLINOIS ATTORNEY GENERAL

I really appreciate having the chance to be here with so many men and women who have spent so much of their time and effort to preserve one of the really priceless treasures we have in our nation.

Like many of you, my grandparents came to this country to escape from a famine that was in Sweden at the time. It had been caused by a drought, and they came over from southern Sweden looking for an area to settle in. They were attracted to this area because of its incredible beauty and because of this tremendous water supply we have in Lake Michigan.

Like the millions of others that came to this area, they built their homes right near the lake. I remember when my dad would take me out into Lake Michigan and Government Pier in Indiana to catch the perch.

Having gone to school in Southshore, we played basketball near the lake and swam in it, and our whole life has revolved around it. In fact, my Mom and Dad met alongside the lake and I met my wife alongside the beach.

So I was shocked when my children started coming back from swimming with ear infections and eye infections. And my wife once got salmonella when she went swimming. And Billy and I would go fishing and there were no more perch in the lake.

I realized that in 25 or 30 years that had gone by during which we had seen so many tremendous scientific advancements--rockets to the moon, computers that could solve tough mathematical problems, space stations that could orbit around the earth sixteen times a day, and all these terrific advances of the whole nuclear age that had come in at that time--that during that same period mankind had poured more pollution and poison and filth into the environment than in the millions of years that he had existed on this planet.

In 1969, when I took office as the Attorney General, not only were all the beaches closed in Lake County, but we were told that Lake Michigan was a dying lake and would be dead in another 8 or 9 years. First thing I did was to try to find out what was going on.

So we sent a crew of former criminal prosecutors, headed by a bright young lawyer named James Thompson, up to Lake County to discover why our state park was going to have to close its beaches. And we were shocked again, to find out that not only was raw sewage being poured into the lake, but that virus and cholera germs, typhoid and salmonella were being dumped into the water that 8 million people were depending upon for their recreation, their health and perhaps their very lives.

So the first challenge I really had as the state's chief legal officer was whether we had a legal system that could deal with the challenges of Lake Michigan.

I had gone through law school with the presumption that for every wrong, there should be some kind of a legal remedy. As we started looking into the lawbooks, there wasn't an EPA on the books, nor was there a state EPA or a federal EPA; in fact, there really wasn't much at all that we had in the way of laws in those days that could protect one of our most priceless heritages.

So when we talk about the cases that were filed involving Lake Michigan, we're not just talking about the scientific aspects of it, as important as they are, but we're talking about whether or not our American system of justice that affects our lives could deal with some of the problems that were being created that didn't exist when I was in law school a few years before.

The first thing that we were able to accomplish by utilizing our legal system, was to help put the spotlight on it. A tremendous job was done by the media in alerting people as to not only about what had happened to the lake, but about what could be done about it.

And I remember when a fellow dipped his hand into Lake Michigan and came out with that famous emblem of the black hand that really was the trademark of the lake for years.

The first cases involving cases like Northshore Sanitary District, U.S. Steel and Interlake, were all brought under common law nuisance. In a way they were related to the public trust doctrine that was handled so very well by one of the publications that was part of this conference. They dealt with the question of protection for the people of our states, and for future generations, the common asset that was held in trust by all of us for future generations.

And what they really said, was that the Attorney General historically has been the attorney for the sovereign dating back to the days of the King of England.

The difference in our country is that the sovereign isn't a king or any governmental official, but it's the people. So we had the right to go into court to represent the people in preserving their possessions or priceless asset.

The scientific aspects were just as important. We couldn't go in and say that we wanted to ship the pollution to the moon, or to drill a hole and put it in the center of the earth--we had to prove that we did have the scientific knowhow in this country to be able to have a strong economy, to be able to produce steel and to produce chemicals, and still not destroy the air and water that we depend for our health and our very lives. And we used the people from industry to prove that that could be done. And in those early cases they were ones that we were able to dramatize.

The U.S. Steel case's significance was that it was one of the oldest steel companies in the nation - one of the largest - yet we were able to produce the technology that could totally recycle the waste and have not one drop of it go into the lake. We demonstrated a closed recycling technique that hopefully could result in the goal of total elimination.

The next case was, of course, whether we could do anything about the pollution sources in the neighboring states--whether the people in one state could say to communities and industries in other states, "You don't have a right to lower our environmental standards." This involved not only the large steel and chemical cases in Indiana, but of course the case that I ended up spending 12-13 years of my life on, the case against Milwaukee.

The first time that we went up to the Supreme Court, which is now 15 years ago, we argued that we did have the right under a federal common law. And the Supreme Court at that time ruled that there was, in fact, a federal common law, and that we did have the right to go into the federal court system and prove that the viruses and contamination stayed alive when it got into Illinois.

That was a tough case that went on for a long time, but it was proved beyond any question of a doubt, and the judge ruled on it.

In the meantime, all of us working together were able to help bring some laws into legislature and Congress. In fact, my law partner, George Burditt, was the main sponsor in the Illinois Legislature of the Illinois EPA.

We realized that it was an essential need to bring people with scientific and environmental backgrounds into this role of helping to develop the regulations and enforcement procedures for government. However, what happened, and this was in Milwaukee too, when the case went back to the Supreme Court, and I was no longer the Attorney General, they said that the passage of the Clean Water Act eliminated this federal common law concept. That presented us with the real challenge that we were faced with all the way along. Could we develop the laws to deal with this?

In other words, as long as raw sewage was going into the lake and jeopardizing people's health and their lives, we had to keep working for some legal way to deal with that problem. And course since I was no longer the Attorney General, we took advantage of another aspect that had gone into the law, and that's the right of an individual citizen to be able to file cases.

Having had open heart surgery, one of the requirements I had was to get out and jog every day. As I'd run along the lakefront I'd hear the snap, popple and crack of little balls of fecal matter that were washing up onto the shore of the lake that our kids are swimming in. And because of my background and of having spent the time on the issue, I realized it was coming from the Hammond area. It was a unique combination of waste from both their industrial and waste sewage areas. And it was not only important to get a handle on that because the beaches had been closed by then for 17 days, but to see whether or not we could do something within our legal system to keep this issue alive after the Supreme Court in Milwaukee had knocked out the federal common law.

So we took the case. We sued Hammond, joined it into the Milwaukee case, and went back up to the Supreme Court. And they said, "Too bad we no longer have the federal common law in this country as far as water pollution is concerned." But what also came out of that case was the request for the establishment and identification of all of the sources of pollution into or out of

Lake Michigan. Even more important was a program to deal with those elements that lowered the water quality level of the lake. Not just from the numerical, but from the aspect that was enumerated as the four freedoms to be free from odor, free from bad taste, free from visual shame or free from anything that's objectionable and a contaminant.

So we have a vehicle where each of the states now have identified all the sources of pollution that would infect the water quality.

Now we face a challenge to create follow-up programs to be put in place by each of the states or by the federal government to control those pollution discharges. So it looks like, for the moment, that we do have the means to be able to preserve Lake Michigan and to set a pattern for the nation.

But now we see this whole new
question of toxic wastes and hazardous materials starting to come up. Just as we get to the turning point, as far as the sewage and the many of the normal pollutants that we're used to, we're now dealing with chemicals and hazardous toxic materials that didn't exist a few years back.

We just saw a decision the day before yesterday that affected one of those problems in Waukegan Harbor. It's probably been 10 years ago since I first filed suit up there as a state issue.

Later, of course, the Superfund was created, and that took preeminence in it. But that decision handed down by a fine judge that ruled, based on what the law seemed to be, can't be allowed to stand. We can't have the situation that we've seen happen at Love Canal or in Times Beach, Missouri.

I filed a case in 1977 stopping a scavenger from tarring the roads with waste oil material in southern Illinois. I tried to point out that the PCBs and PBBs could cause cancer and birth defects. We stopped it from ever happening in Illinois, but they went over to Missouri and paved the roads in their towns. We just paid $32 million of your money to buy back that town. It's not the price that really counts, but the price of how many of those kids are going to have birth defects.

So to say that there simply was a legal decision, and it was lost, can't be tolerated. We have to move ahead. I happen to think if they appeal that decision, that the contaminated area will be treated different from the area that isn't contaminated, and that the agency does have the right to go on to the land that's contaminated. But certainly it's an area that Congress is going to have to deal with if the court system falls short, because it's identical to the Milwaukee situation. It's one thing to say, "Okay, now we win a lawsuit." It isn't a question of games or who's going to win or who's got the scalps. We're talking about not tolerating a situation where one fifth of all the fresh water in the world is poisoned by pollutants.

We're talking about starvation of men, women and children because they don't have the water to irrigate their crops in Africa. Not to realize how vital water is to our lives is foolish. It's vital to our industry and our way of life, but it's essential to our survival. You can pick up the paper and they're talking about the fact that we're starting to have our groundwater

contaminated, and that we're running out of water. Not just in Africa, but our own country in the high plains, Kansas and Nebraska, where we get our food from.

We're running out of water in Arizona, Colorado, California and in the western suburbs of Illinois where I live. This isn't something that's happening off on the moon or in some other country far away.

When we talk about "Oh, we've got to watch all this water or those people in Nebraska are going to get it," we're not talking about some enemy country, we're talking about our fellow Americans. We're talking about our food supply and our economy.

We know that the Great Lakes region is a prosperous wonderful region because we've got this priceless resource. We're all part of the same country, so we have to realize that somewhere down the line we're going to have to face up to this issue. We can't sit here and see our lakefront being raided and our piers under water.

We have to figure out that we have to worry about somebody else not getting water so that they can water their lawn or flush their toilets or have drinking water, let alone irrigation.

But there is a way. The same concept of utilizing the scientific knowhow and technology that has made our country great and our industry strong, can be used to allocate and maintain our water supply. The thing that we're doing with Lake Michigan is setting an example for the nation that we can totally recycle. We can have zero discharge. We can treat it. The economics of using air and water as free sewers just don't make sense. Why not take that technology and start a plant at the Chicago River?

You know, Indiana, Michigan and Wisconsin weren't necessarily wrong, even though we were on the other side of that case on the lake diversion. They said "Well, you fellows ought to be able to put that water back in." Of course, we said that is what caused the typhoid epidemic back in the 1890s. I don't really think that you are going to like the sewage going into the lake. And that's where the diversion issue came from.

Why can't we treat it so that the water can be put back into the lake if we need it, so that in times when the water level is high, like it is now, and if you want to do something good for your state treasury, you can sell it. Sell it to an area that needs it to irrigate their crops.

Then you say, "Well, what's going to happen when the cycle changes." I got a wonderful investment tip while I was here at the conference. I've been trying to figure out how I'm going to finance some cases that we don't make any money on. I finally got the answer talking to one of the people here. They said the thing to do is to buy some lots that are behind lots on the lake, because in a couple of years they're going to be the lake front property.

Why in times when our land is being put under water, where Zion may become the first underwater state park in the history of this country, can't we figure out some way of letting our western suburbs have some of the water

they need? Or to help clean out the Chicago River with it? Why don't we use our scientific knowhow so that we can recycle our sewage and treat it, so that when you need to turn it around all you have to do is open up the gates.

You don't have to call back the Army Corps of Engineers to do another engineering miracle. Once that water is protected from the pollution and the toxic materials that has been going into it, you can use it to put the course back the way that it originally was.

These are exciting times and you all have terrific responsibilities and challenges, but you've also got an opportunity to preserve for future generations, not just the beautiful lake, but a way of life. The way of life that has made this country the envy of every nation in the world.

It was mentioned that I had the good fortune of going over to several countries to help work on their environmental problems, but the one thing they all had in common - they all said how lucky you are to be from a place that's not only got the natural resources, but a system of justice that protects your rights, including the right to live and work and raise your families in a decent environment. Thank you for inviting me today.

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GENERAL SESSION ON ILLINOIS' LAKE RELATED POLICIES

DAVID N. BARKHAUSEN

ILLINOIS STATE SENATOR

David N. Barkhausen represents Illinois' 30th District in the State Senate. He represented eastern Lake County for one term in the House before his 1982 election to the Senate.

Sen. Barkhausen serves on the Senate's criminal law (judiciary) committee and revenue committee. He has sponsored legislation to provide assistance to crime victims and to strengthen laws against murder, drunk driving, stolen property, child pornography and vote fraud.

In 1982, he was named "Legislator of the Year" by the Illinois Wildlife Foundation.

Sen. Barkhausen is a practicing attorney and has argued cases before the Illinois Supreme and Appellate Courts, the U.S. District Court and the U.S. Court of Appeals. He has recently announced his candidacy for the office of Attorney General in the 1986 election.

Sen. Barkhausen holds a law degree from the Southern Illinois University School of Law, awarded in 1976, and he graduated with high honors from Princeton University's Woodrow Wilson School of Public Affairs in 1972.

WOODS BOWMAN

ILLINOIS STATE REPRESENTATIVE

Woods Bowman is currently serving his fifth term as state representative, 4th District. He is chairman of the Appropriations II committee and chairman of the Democratic Study Group. In addition, Rep. Bowman serves on the committees on aging, public administration, administrative rules, and the committee on government operations of the State-Federal Assembly of the National Conference of State Legislatures.

Rep. Bowman is a member of the board of the Howard-Paulina Commercial Development Corporation, the Illinois Association for Infant Mental Health, Community Action Partnership of Evanston (CAPE), Community Coordinated Child Care of Evanston, and Progressive Chicago Area Network (PROCAN).

He received his doctorate in economics from Syracuse University in 1969, a master's of public administration from Syracuse in 1965, a bachelor's in economics from MIT in 1963 and bachelor's in physics in 1964.

Rep. Bowman has received awards from the Illinois Environmental Council, the Statewide Coalition on Human Services, United Christian Community Services, the Illinois Association of Nutrition Project Directors and the Illinois Association of Workers for the Blind.

DAVID R. MOSENA

CHICAGO DEPARTMENT OF PLANNING

David R. Mosena is the deputy commissioner for the City of Chicago's Department of Planning. He is responsible for management of central area and neighborhood development planning, capital facilities planning, demographic research, energy planning and policy studies.

Mr. Mosena serves as a liaison between city departments, community groups and other units of government in and around Chicago. He has published books on streamlining land use regulation and on health planning and the environment.

Before joining the Chicago planning department, Mr. Mosena served as director of research with the American Planning Association from 1977 to 1983. He previously served in several research capacities with the APA's predecessor, the American Society of Planning Officials.

He is a member of the American Institute of Certified Planners and a founding board member of Partners for Livable Places, Washington, D.C.

Mr. Mosena was awarded a bachelor's degree in business administration in 1968 and a master's in regional planning in 1971, both from the University of Tennessee. He holds a certificate in environmental planning in Britain from the University of Manchester, England.

SHARON SHARP

ILLINOIS DEPARTMENT OF COMMERCE AND COMMUNITY AFFAIRS

Sharon Sharp was appointed deputy director of marketing for the Illinois Department of Commerce and Community Affairs in April, 1984. She oversees the state's film office, the office of international business and the office of tourism.

Mrs. Sharp served as the special assistant on women to Governor James R. Thompson from 1980 to 1984. She became the first Illinois woman to be nominated for a major statewide office when she was the Republican party's candidate for Secretary of State in 1978.

She previously served as clerk of Elk Grove Township and as a member of the Illinois Community College Board.

Her community and professional memberships include the Illinois Development Council, the International Platform Association, the American Economic Development Council, the League of Women Voters' Education Fund Advisory Board, and the City Club of Chicago. Mrs. Sharp serves as co-chairman of the Republican Central Committee of Cook County and is director of the Illinois Federation of Republican Women.

MICHAEL B. WITTE

ILLINOIS DEPARTMENT OF CONSERVATION

Michael B. Witte was appointed director of the Illinois Department of Conservation by Governor James R. Thompson on November 15, 1984. This department conserves, preserves and enhances the state's natural and cultural resources, and maintains outdoor recreational sites.

Prior to his appointment to the Department of Conservation, Mr. Witte had served as director of the Illinois Department of Energy and Natural Resources since 1981. In that capacity he was chairman of the Board of Natural Resources and Conservation, chairman of the Energy Review Board, chairman of the Illinois Coal Research Board, chairman of the Governor's Sunset Task Force on Utility Regulatory Reform and a member of the Illinois State Museum Board.

Since January, 1977, Mr. Witte has served in several Illinois government posts, including deputy director of ENR, assistant director of the Institute of Natural Resources, assistant director of the division of energy in the former Department of Business and Economic Development, and manager of the state's energy conservation programs.

Mr. Witte is a graduate of the University of Michigan and received his MBA degree from the University of Illinois in May, 1985.

RICHARD J. CARLSON

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

Richard J. Carlson is director of the Illinois Environmental Protection Agency. Dr. Carlson was a special assistant to Governor Thompson from 1977 until he assumed the EPA post in 1981. He has been director of research for both the National Municipal League and the Council of State Governments.

Dr. Carlson was the coordinator of research for the Sixth Illinois Constitutional Convention and he served as assistant to the majority leader in the Illinois Senate.

Dr. Carlson received his doctorate in public administration from the University of Illinois and is a coauthor of *The Illinois Legislature.*

CRAIG E. COLTEN

ILLINOIS STATE MUSEUM

Craig Colten joined the Illinois State Museum in May, 1984, as associate curator, historical geography. Prior to joining the Museum, he was an instructor at Xavier University and the University of New Orleans. In addition, Dr. Colten has been a consultant to Burghdal and Graves Architects in New Orleans and TrekAmerica Tour Company in London.

Dr. Colten is a member of the Association of American Geographers, the Illinois Geographical Society and the Illinois Historical Society. He received the J.B. Jackson Landscape Research Award from Syracuse University.

Dr. Colten was awarded a doctorate in historical geography from Syracuse University in 1984, a master's in historical geography in 1978 from Louisiana State University, and a bachelor's in geography from LSU in 1974.

THE ILLINOIS GENERAL ASSEMBLY'S ROLE IN THE DEVELOPMENT AND PROTECTION OF LAKE MICHIGAN

HONORABLE DAVID N. BARKHAUSEN
MEMBER, ILLINOIS STATE SENATE

The theme of this year's conference--the development and protection of the Great Lakes--implies that government, in general, and we in the General Assembly, in particular, have a two-fold responsibility towards Lake Mighigan and the people it affects--to influence the development of the Lake in a desirable way while still protecting the quality of the Lake's water and the shoreline.

My legislative district includes two lakefront communities, Lake Forest and Lake Bluff. But it is fair to say that all of my district and, to some extent, the entire state has a stake in our guardianship over the Lake and the development of its resources. In fact, my residence in Lake Bluff is only one-half mile from the Lake. So, naturally, I have an interest, legislative and personal, in the use and abuse of Lake Michigan.

The abuse of the Great Lakes is certainly far less than was the case in the past. We have come a long way in many respects since the pollution issue came to the forefront 15 years ago. The two EPAs, federal and state, were created about the same time, and, as part of their statutory mandate, they have succeeded in significantly curtailing Lake Michigan pollution from industrial and municipal sources. There have been many successes, but the battle, it seems to me, is just beginning or, at best, we are at the end of the beginning.

Despite these achievements, the Lake is by no means free from danger. Although $2.3 billion has been spent since 1973 on wastewater treatment in Illinois, more recently, federal funding for those projects has been substantially cut back.

The Build Illinois program is designed to fill this void. As the Governor may have mentioned, part of the Build Illinois program will make up for the 20 percent decrease in federal grants from 75 percent to 55 percent so as to lift the financial burden from local governments. That burden was, in many cases, simply too heavy upon our cities, towns, and villages. Additionally, we have been funding backlogged sewer projects with remaining funds from the Anti-Pollution Bond Act. That program began in Illinois in 1970, and raised $750 million for sewer and wastewater projects. But nearly all of those funds will be gone in the next fiscal year. I believe we must acknowledge the reality of a smaller federal role and be prepared to authorize additional bonding authority, whether it is part of Build Illinois or some other initiative. I would hope to see a reauthorization of that bonding authority and would support such legislation.

One example of where we in Illinois have taken up where the Feds left off is in my own district. The North Shore Sanitary District had backlogged projects that simply could not proceed without some assurance of funding, but Build Illinois and the use of remaining pollution bond funds has allowed the NSSD to proceed ahead on a four-year schedule with a $12 million grant. This gives the NSSD the certainty and continuity needed to build, as is the case with any capital development project.

On the question of industrial pollution, attention has focused on the issue of toxic or hazardous wastes. Those industries which discharge their waste directly into the Lake are under the federal mandate to use the "best available technology" to remove the toxic substances in their wastewater. That particular approach was begun by the USEPA in the early 1970s and so far appears to be working. However, we still have left unresolved the problem of toxic wastes which were discharged before the "best available technology" strategy was implemented.

One example of this is the Waukegan Harbor Superfund site where 1.7 million pounds of PCB deposits were discharged by Outboard Marine Corporation plant directly into the water.

The difficulty of cleaning up this site is four-fold. First is the frightful cost of $21.25 million. Second is the fact that the clean-up could, if not handled properly, pose a greater threat than leaving the PCBs dormant at the bottom of the harbor. Third is the failure so far to clearly assess liability as between the producer of the PCBs, Monsanto, and the manufacturer of the final product and the direct polluter, OMC. The government took the position, wrongly in my opinion, that the clean-up would not proceed until fault was apportioned between these two parties. This obviously contributed to the delay. In fact, the USEPA now seems willing to proceed with the clean-up and sorting out the liability later.

If all of these factors were not sufficient obstacles, the Federal Appeals Court has just thrown up another road block. Just this week, the 7th Circuit Court reversed the trial court opinion regarding the EPA's legal authority to enter private property to eliminate a "non-emergency" public health threat. The appellate court's opinion was one of first impression regarding this issue and, in effect, prevents the USEPA from entering OMB property without their consent in order to conduct the necessary on-site testing preceding a clean-up of the PCBs.

This problem of toxic and hazardous wastes has been with us for many years now, and is not going to be resolved overnight. Nonetheless, several steps should be taken. One is the reauthorization of the Federal Superfund statute. Second is greater state participation, both in funding and in proceeding with certain projects without waiting for the initiative to come from the federal level. Third would be to proceed with projects without awaiting the outcome of protracted litigation which will apportion liability between multiple defendants. Fourth would be an amendment to the Superfund statute, which would give the USEPA the jurisdiction to enter private property in those "non-emergency" instances such as Waukegan Harbor.

An additional threat to the Lake's water quality, and one over which we are told we have no control, comes from out-of-state sources. The same Federal Appeals Court has recently held that the State of Illinois has no legal authority to stop the pollution of Lake Michigan by industries or municipalities located in neighboring states. In the meantime, the Lake is being polluted. We still have 42 toxic "hot spots" on the Great Lakes, and we know of the warnings not to eat fish laden with PCBs. Suffice it to say that there is still much to be done, and the solutions lie only partially in our own hands.

The second part of our topic is the development of the Lake's resources, which has been the subject of a great deal of recent legislative activity. Let me mention a few initiatives.

The use of Lake Michigan as the source of a public water supply is increasing significantly. Many lakefront communities have used the Lake for that purpose for many years, but we see more land-locked communities using Lake water as their existing sources either run dry or are contaminated. This past session, at the request of several Lake County communities, I sponsored legislation which amended the Joint Water Action Agency statute so as to allow more communities as well as Lake County to participate jointly in intergovernmental agreements of that nature. The legislation also provided for bonding authority, pursuant to referendum, to pay for the construction of a Lake water system. The northwestern suburbs have successfully lobbied for similar legislation which will give them a way of obtaining Lake water.

The same is true of DuPage County, which is one of the fastest growing areas in the country. Legislation sponsored by the Republican legislative leaders from that county is now law and provides for the establishment of the DuPage County Water Commission as a local unit of government for the sole purpose of providing a supply of Lake water to DuPage County communities. The legislation itself contemplates substantial capital expenditures for the construction of the pipeline from the Lake to DuPage, along with the associated facilities and rights of way or easements. The price tag for this is estimated at $350 million, 99 percent of which is going to be paid by DuPage County taxpayers through a combination of sales tax, property tax and general obligation bonds.

Another type of use of Lake resources is recreational; specifically, a major state role in planning and constructing harbor facilities. The Illinois Department of Conservation has proposed the construction of a 1,500 wet-slip marina and related facilities at the Winthrop Harbor site. It will be the biggest facility of its kind on Lake Michigan, and I commend the Department of Conservation for their initiative and foresight. I assume Director Witte will want to discuss this project, so I will leave the details to him.

I'm happy to tell you, however, that the Winthrop Harbor project is not the only lakefront development underway or planned. Waukegan Harbor recently completed a 764 wet-slip marina; all of the slips are rented, and there are about 200 boaters on the waiting list. That new facility currently brings in about $1 million in slip rental fees and gasoline sales, and will increase when the harbor facilities are further expanded as is planned by the City and Port Authority of Waukegan. Included in the planning is the redevelopment

of lakefront property for the associated marina facilities, and perhaps construction of condominiums and other improvements that will radically upgrade the run-down character of the lakefront.

In the North Chicago area, the Foss Park Marina is planned, using $500,000 in Build Illinois money. The point should be quite clear; namely, that lakefront development creates jobs, tax revenues, and meets the demand for recreational facilities. Cities such as Waukegan and North Chicago are sorely in need of economic redevelopment, especially in their downtown areas. These harbor facilities can help meet this need, plus they can contribute to the enhancement of the quality of life.

It can be effectively argued that recreational facilities such as marinas and harbors are one element that determines the attractiveness or "liveability" of an area. If we are to enhance the desirabilitiy of living in Northeastern Illinois, and compete for the high-tech economy, especially in biotechnology which is important to Lake County, and stop the "brain drain" to the Sunbelt, we must proceed with harbor development as rapidly as possible.

Of course, part of developing the lakefront includes keeping the shoreline intact. We are all too familiar with the recent elevation in the water level in the Lake, which has significantly increased the rate of shoreline erosion. We in Illinois are attempting to save the shoreline through a variety of methods. At Illinois Beach State Park, for example, the Department of Conservation will spend just over $200,000 this year for "riprap" in a particular area of the park. There are 5.8 miles of shoreline at the park, and the plan is to give shoreline protection the highest priority by use of riprap, sheet metal bulkheads, or cube revetment. Additionally, the construction of an off-shore breakwater with the cooperation of the Corps of Engineers is possible sometime in the near future at the cost of $12 million. Obviously, much more needs to be done than protecting the 5.8 miles of state park shoreline. Federal, municipal or private property similarly must be protected, and cooperation with Canada will have to be secured to keep water levels down on the lower lakes.

Although we have made substantial progress towards protection of the Lake, the task ahead is formidable. Many problems persist, and solutions to all of them are not readily apparent. If we expect to drink the water from the Lake or enjoy the Lake for boating, swimming or fishing, then we must continue our vigilant stewardship of this precious resource.

Let me conclude with a quote from President Theodore Roosevelt, the pioneer of the conservation movement:

> "The conservation of our national resources and their proper use constitute the fundamental problem which underlies almost every other problem of our national life."

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THE ILLINOIS GENERAL ASSEMBLY'S ROLE IN THE DEVELOPMENT AND PROTECTION OF LAKE MICHIGAN

HONORABLE WOODS BOWMAN
STATE REPRESENTATIVE, DISTRICT 4
ILLINOIS HOUSE OF REPRESENTATIVES

Thank you very much, distinguished panelists, colleagues and participants. I'm pleased to be able to be here to speak to you on the role of the Illinois State Legislature in Lake Michigan planning and water quality. I live very close to the lake. The 4th Legislative District consists of the lakefront from Greenleaf Avenue in Chicago all the way up to the northern boundary of Evanston. I live very close to the lake myself, and I go out running along the lake every morning, and I truly love the lake. It's never the same twice. It has a different look, a different character, a different feel, each day. And it is something I personally feel very close to.

The topic that was assigned to me is one that is difficult on two grounds: (1) many of the issues that we have to deal with in lake planning and utilization have a very strong federal component to them. Even if we acknowledge the retreat of the federal government from funding of specific programs, we must acknowledge that the federal government, by virtue of passing the U.S. EPA Act, for example, has preempted common law in this area, as former Attorney General Scott reminded us today at lunch. Furthermore, the pollution in the lake is a multi-state problem. The pollution that affects us in Illinois can be, and is generated by the neighboring states of Indiana and Wisconsin, and also by states beyond the boundaries of the lake basin. I am told that chemicals used in agricultural production in other states, that are banned for use here in Illinois, have been detected in lake waters because they are airborne. They are then reportedly deposited in Illinois in the form of acid rain and pesticide rain, and in turn affect the water quality in the lake basin.

So there is no mistake about it. There is, and will remain, a strong federal role in lake planning and resource utilization. That leaves the state in a particularly vulnerable position. We can do things to affect the local quality, and we can certainly do things to avoid creating problems for neighboring states, such as restraining our own pollution. But these are inevitably local in nature.

Another frustrating aspect of my topic has to do with the nature of the legislative process, and not with the nature of the problem itself. The state legislature is for the most part a reactive body, and in Illinois, like in so many other states, it is a citizen legislature. Most members of the legislature are part-time, and the legislature meets far less frequently than the U.S. Congress. It is also staffed far less extensively than the U.S. Congress. In fact, it was only fifteen years ago that the legislature had no staff at all. For example, when I first came to the legislature I met the first staff member in the house to ever have served in the House of Representatives. Legislators did not have offices, or telephones, or desks,

except for those desks on the floor of the House. They did not have secretarial support, nor did they have district expense allowances, "allotments", which would permit them to open district offices.

So we have, as a citizen legislature, developed a habit of responding to initiatives, either federal or executive branch initiatives, without the staff resources necessary to develop the kind of long-range strategic planning for legislative initiatives that the federal Congress has been able to evolve. Now I think that will change. As the states are being expected to assume more responsibility, not only in the environmental area, but in other areas as well, I think the state legislatures will become more professionalized, and that will inevitably mean more staffing for a professional legislature. Indeed, the process has already begun in Illinois.

But we are often reactive. For example, one issue--coastal zone management--to use a catch phrase, is the management of the utilization of the margin between land and the water in the great lake basin. Why is this important? Because the way in which the lakefront is developed will have implications for neighboring communities, especially for the community doing the development itself. The Illinois legislature has grappled with this issue on a couple of occasions, but always in response to a federal initiative, and always in response to the prospect of some mysterious and elusive source of federal funds. Some communities have supported coastal zone management, such as the city of Chicago; other communities have rejected it, notably some northshore communities. Consequently, the bill has never passed either chamber. In the past year, when the prospect of federal funds looked even more dim, I'm not even aware that the bill was introduced, and the legislature now has been in session a year.

So that is one example of our reactive spirit in the Illinois legislature. In fact, coastal zone management is something that Illinois could do on its own if it chose to do so. The city of Chicago has a lakefront protection ordinance, and perhaps it could be strengthened. Certainly lakefront protection throughout Illinois could be strengthened if all communities acted in concert and participated in the decisions about what to do with the lakefront. There is no reason that Illinois could not have its own version of coastal zone management legislation. But so far, the legislature has not seen fit to take the initiative, and I suspect without the enticement of resources going to those communities to entice them to buy into such an arrangement, I think that we will probably not have legislation of that kind here in Illinois.

And yet legislation of that kind is very important, as Senator Barkhausen's speech suggested, because the lake is many different things to many different people. It is a source of water supply, a source of recreation, and it is a disposal site. It is many things, and we need to balance those interests. Only a lakefront utilization ordinance or law can do that. But we are a long way from that.

Up until this point I think much of the emphasis on lake protection and enhancement has focused on water quality, and we will probably continue to wrestle with that for many years to come. But I see another issue that is emerging to eclipse water quality, and that is the availability of water for

not only residential use, but also for commercial and agricultural use. I spent some time this year traveling out West, and scarcely a day went by in any town that I happened to visit -- no matter which city or village you visit in in the western part of the United States -- you can pick up a newspaper and find an article about water and about the availability of water, either for agricultural purposes or for commercial/residential purposes. In fact, the Southwest and the West is growing so rapidly that water probably will be the first growth constraint they bump up against as they pursue their development in a helter-skelter, headlong fashion. And the Great Lakes basin, of course, is one very enticing opportunity to gain some additional water. Of course, this is not a new idea; it has been around for a while. But as the development in the Southwest and the western part of the United States proceeds apace, it will become more and more of a public issue that will be the subject of national debate.

Now there are a number of issues that one needs to deal with. We could conceivably sell the water and achieve some revenues for treasuries, assuming there was a concensus that it was a good idea to do, but I just want you to focus on this statement for a second. Who gets the proceeds? The water belongs to all communities along the lakefront and all states that border the lakefront; so are we selling Illinois water? Are we selling Michigan water, Indiana water, or Wisconsin water? I mean who cares where the pipe enters the lake--it's the same water and will affect the water levels in all neighboring states.

How are the revenues to be apportioned? That's going to be a terrific fight. Even assuming that we could agree to sell the water in the first instance. Then, of course, there's an even bigger problem. Even assuming that 100 percent recycling is technologically feasible, and I say assuming that, because of course evaporation is one problem. If you use this in agriculture, the water is going to evaporate. But don't forget one thing. Chicago sits astride the continental divide; not the famous continental divide on the Rockies, but a continental divide nevertheless. The water that fell east of Harlem Avenue in Chicago--before the river was reversed--flowed into the Great Lakes Basin. The water--rainwater falling west of Harlem Avenue--would flow into the Gulf of Mexico through the Mississippi River drainage basin. So if we are selling water to the western part of the United States, clearly we are transporting water from one drainage basin to another drainage basin. And that raises enormous questions--ecological questions.

So it's not simply a financial question or simply a question whether the water level is high this year, so maybe it's okay to transport it to the western part of the United States. It's a different drainage basin, and there are some very serious questions raised, with which we have not yet grappled. I predict though, because economic development in the Southwest is continuing apace, that this will become a major issue.

In our own state, it has been pointed out already, we have water allocation questions arising here. We are, at the present time, under a limitation as to how much water can be taken out of Lake Michigan. So that is not the critical question. Allocation is important, and we are continuing to debate that, and to change our allocations as development proceeds here in the Chicago metropolitan region. But if the federal government does get into the

act, and does begin to make decisions about which regions of the country get Great Lakes water, then of course that will have significant impact on the allocation within our region. And that will produce other debates that now are merely lurking in the background.

So these are some of the major issues that I see in front of us. We still have the problem of waste disposal, particularly toxic substance disposal. And we have not by any means solved those problems. I merely wanted to take the time available to me to look ahead, perhaps to the next decade, to see what will be emerging. We will have to begin thinking about these issues now, if we are to deal with them effectively at that time.

In conclusion, I would just like to comment on the recent court of appeals decision regarding the Outboard Marine Corporation and the U.S. EPA. I am not an attorney, so I do not know the answer to this question. But, I am a member of the State Legislature in the State of Illinois for whom the Outboard Marine question is a matter of pressing public policy, especially for my lakefront community. I do think that we ought to ask our legal specialist whether Illinois law could be modified in order to give the United States EPA officials, upon application to the state EPA, access to private property. If it can be changed, I for one feel it should be changed and will make every effort to do so.

Thank you.

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CITY'S POSITION ON WATER AND LAND USE AND DEVELOPMENT

DAVID R. MOSENA
DEPUTY COMMISSIONER, CHICAGO PLANNING DEPARTMENT

I would like to focus on three major policy initiatives and other actions the City is currently engaged in that affect the quality of development along the lakefront and the adjoining river systems. They have direct effects on the aesthetic and environmental quality of our cherished water resources.

These initiatives include Navy Pier, Downtown Riverfront Development, and Southeast Chicago and the Calumet Area.

Navy Pier is a treasured Chicago landmark and the crown jewel of our lakefront. The Mayor's Task Force on Navy Pier, formed last March, released its draft findings and recommendations for public review and comment earlier this week. It recommends development of the Pier as an urban park with extensive cultural, educational and community activities geared to the general public.

Specifically, these activities will include expositions, cultural events, museums, educational institutions, entertainment events, some limited retail activity, active and passive park uses (both open and enclosed) and recreational facilities for year round use.

These recommendations are in sharp contrast to past proposals for commercial, office, residential and hotel developments on the Pier. Many other parts of the City remain viable for these kinds of development (e.g., Dock and Canal properties just to the west).

The Task Force concluded that the focus of Navy Pier should be on protecting this unique heritage for the public along with the rest of Chicago's magnificant lakefront park system. There is only one Navy Pier, and it belongs to everyone--the Task Force also made recommendations on phasing the redevelopment of the Pier, creating a quasi-public management entity to run it, and on needed improvements for pedestrian, vehicular, and transit access to the Pier.

To initiate redevelopment of Navy Pier, the Mayor and the City Council have approved $15 million in the 1985 General Obligation Bond Issue for improvements to the Pier, including structural repairs, the upgrading of sewer and electrical systems, improvements in fire protection, and roof repairs.

Downtown Riverfront Development is based on the Chicago Waterway Plan that was produced by our department. The Council adopted a set of zoning ordinance amendments in 1982 that were aimed at protecting and enhancing the environmental quality of Chicago's waterways.

All major waterfront developments are now required to provide appropriate shoreline treatment, including public waterfront paths, plazas, overlooks, esplanades and access points where appropriate; provisions for landward

connections to maintain continuity and linkage with nearby public edge improvements at locations of active commercial/industrial waterfront activities; and provisions for adequate setbacks for bulk storage facilities to prevent littering or leaching of pollutants into the waterways.

The shoreline treatment plan also includes stabilizing treatments for waterway edges with landscaping screening for visual relief and safety provisions for landside and waterside users, and will provide boat landings and/or water oriented commercial facilities where appropriate and feasible.

A host of exciting and innovative new developments are underway in the Central Area, which are water oriented and will enhance the river's edge. River City is an architecturally stunning major residential development in the South Loop that will include a river-edge promenade, shops and marinas. Oxford Development is a large multi-use complex adjacent to Marina City. Now under construction, this project will include a dramatic river-edge component with public access and overlooks.

The Dock and Canal, at 48 acres, is one of the largest multi-use development projects in the country, and is located on the north shore of the Main Branch just east of Michigan Avenue.

The Department of Planning spent the major part of a year producing a detailed set of design guidelines for the project, upon which the developer's planned development ordinance was based. That ordinance passed the Chicago Plan Commission two weeks ago. Developers and their site designers have produced an exciting set of plans for a one-half mile long river-edge promenade with terraces leading down from Michigan Avenue to the river's edge, including trees, plazas and fountains.

Ogden Slip, contained within the development, will be a major design feature of the project, with a suspended plaza at its western end and tree-lined boulevards along its edges. Residential units will line the slip, with ground floor retail uses such as restaurants along the boulevards.

A Streeter Point Park is planned for the eastern end of Ogden Slip, with guarantees of full public access. The planning development ordinance also requires the developers to take whatever steps necessary to ensure that the water quality of Ogden Slip, which dead ends at the west end, meets all federal and state water quality standards.

The Southeast Chicago/Calumet area suffers from two major trends that have evolved over the last decade. There has been a devastating decline of the steel industry (loss of 30,000 jobs in steel industry alone, plus indirect jobs loss), and a concentration of municipal solid and hazardous waste disposal in the area. These very tough and very serious problems affect the quality of life and development along the lakefront, and the quality of the environment (Lake Michigan, the Calumet River, Lake Calumet, wetlands and ground water).

The Mayor has formed two public/private task forces to squarely address these issues. They are the Task Force on Steel and Southeast Chicago, and the Task Force on Solid Waste. Both task forces are still in session, so although I

can't report their recommendations to you yet, I can give you a sense of where they're headed.

The Steel Task Force was formed in October 1984, and charged with developing strategies to retain and revitalize Chicago's steel industry, and to enhance commercial and industrial redevelopment on the southeast side.

One outgrowth of the Task Force is a strategy to strengthen heavy industry in this area, and to not abandon it. The Task Force has given a stimulus to a "Local Industrial Survey Program," in which funds provided by the City's Department of Economic Development, working with the South Chicago Development Commission, are used to work with individual industries in the area to help them head off their problems before they lead to closure or relocation.

With the decline in steel, one of the major problems in the Calumet Area is finding another new anchor tenant. One of the key recommendations likely to come from the Task Force will be the serious exploration of constructing a cargo and general aviation airport at Lake Calumet. Preliminary prefeasibility studies are now being actively pursued by the South Chicago Development Commission.

The Solid Waste Task Force was formed because Chicago generates an annual 2.5 million tons of municipal solid waste. Four-fifths of it is disposed of in sanitary landfills on the southeast side.

Last January, after a year long inter-departmental study led by the Department of Planning, the Mayor initiated a major new policy direction for the City designed to phase out our dependence on southeast side landfills, and to move towards alternative methods of waste disposal, including waste-to-energy facilities and a major recycling program.

As a first step towards implementing this policy, the Mayor introduced a set of proposed ordinances into the City Council that would ban all new sanitary landfills and strengthen environmental review criteria for expanding existing landfills. These criteria include buffer zones, erosion and drainage control, environmental assessments on site and on surrounding properties, monitoring water wells, protection of wetlands, screening from public view, and preparation of end-use plans. They would forbid hazardous waste disposal in sanitary landfills, stiffen penalties for violations and mandate an inventory and reporting system of all hazardous wastes produced and handled by industry in Chicago. They would increase the City's identification bonding requirements for sanitary landfills and liquid waste handling facilities from $100,000 to $250,000 each, and legitimize the private recycling industry by amending Chicago's zoning ordinance to permit recycling centers and processing stations as special uses in B4, B5, C1 to C5, and M1 to M3 zoning districts. Finally, the criteria would establish appropriate siting and operational standards.

The Mayor also appointed a public/private Task Force on Solid Waste to review and refine his proposed ordinances, to examine a range of alternative waste disposal options, to make recommendations on how to implement these alternatives and to establish a reasonable timeframe for accomplishing these goals.

The Solid Waste Task Force is still hard at work on these tough issues, which involve some environmental trade-offs, not to mention other cost concerns. We've also included start-up funds in Build Illinois for moving forward with a new waste disposal program.

Dramatically changing the waste disposal methods of a city the size of Chicago is a big job, requiring long-range planning and considerable lead time. Our current landfills, as now permitted, are expected to reach capacity around 1991. The important thing is to get started, which we have; and then to keep up the momentum, which we will.

The final outcome will help reverse the trends of socio-economic and environmental degradation that the southeast side has experienced in the past.

It bodes well for the community, its economic redevelopment, and the surface and ground water quality of the region.

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COMMERCIAL DEVELOPMENT OF ILLINOIS' LAKE MICHIGAN RESOURCE

Sharon Sharp
Deputy Director, Marketing and Communications
Illinois Department of Commerce and Community Affairs

A part of my job, besides tourism, international business and films, is marketing the State of Illinois and its economic development programs. That's when you get down to the nuts and bolts of jobs: the bringing of jobs to the State of Illinois.

DCCA's marketing staff last year brought in nearly 31,000 jobs, created or retained in this state. And Lake Michigan has a great deal to do with our success.

There is an old story that when Tip O'Neil was asked what are the three most important things to any campaign he said, "money, money, money." As an industrial development representative, I am often asked what is the most important asset of any state and why would an industrial or manufacturing concern wish to locate in Illinois. In years past, the only words you ever heard were "location, location, location."

Well, the time is coming for many of us in many states across this country when we are going to be asked that very same question again. We'll be asked, "What is the most important reason a high-tech company or a manufacturing concern will locate in any state?" This time the answer will be, "Water, water, water." But not just any water. They will want reliable and good quality water. And in many ways, Illinois and the Great Lakes region will luck out in that factor.

Remember all the hype over the Saturn project when everybody was trying to decide who was going where? Well, Texas was considered. Everybody said Texas had won the project, "They're going to Texas, they're going to Texas!" But many people knew that water would be a factor, and even though Texas was saying they had plenty of it, those in the know wondered how could Saturn go there. Is the water in that Texas lake really reliable? Remember, Saturn was asking for three million gallons of water per day as part of the criteria for site selection. They had to be able to use it and then get rid of it. And you know what? When you start looking for water like that, you're looking for a lot of water. In all the other big site locations that we work on, water is an absolutely major factor.

A friend of mine was in New York recently, and heard a public service announcement on television requesting New York residents to turn off the water while they were brushing their teeth. That type of thing makes somebody who is looking for a place to locate, and to bring their employees, to locate and do any business, stop and think about whether they really want the problems.

I am going to talk a little bit about the Great Lakes region and Illinois today. The Governor mentioned our work in the region because a lot of this is intertwined. Because the figures are so astounding, you probably all realize that one-fifth of all U.S. manufacturing is located along a Great

Lakes shoreline. Seventy percent of our steel production is located along the Great Lakes shorelines. Water has been, and will continue to be, a major selling point in economic development strategy.

In a Recent Fortune article, it was reported that the factors of quality of life and water supply were in the top one-half of 26 ranked site-selection criteria, above state and local personal taxes and above proximity to customers and raw materials. And more and more we are seeing that the quality of life plays an increasing role, judging by our experience with firms who are looking for sites in this country.

There was a survey taken recently for one of the business magazines in which 40 major corporations were surveyed. The only unanimous opinion in the entire survey was that quality of life was the one determining factor in hiring and keeping highly educated technologically sophisticated mobile workforces. That's what companies are looking for and what we are training employees for. And many of those corporate heads believe that, in fact, the Great Lakes region is one that has the potential to develop that asset.

We have seen people go to the glamour spots. We've seen them go to California, Arizona and down south to Florida, but when companies start thinking about their water supply beyond the year 2000, and we hear about states like California, Florida and Texas and their water problems now, people are going to take a hard look at the Great Lakes region. And we hope the State of Illinois. We have a five-year development strategy in Illinois, and in it, the Great Lakes play a role. Our strategy calls for enhanced Great Lakes regional cooperation, and judicious management and economic development of Lake Michigan. We know what we've got here, but perhaps we haven't used it as well as we should.

Governor Thompson was with you a couple of times this week, and I'm sure that you heard of his chairmanship of the Great Lakes Governors. I think it shows that he would take over that responsibility since he believes that Lake Michigan and the Great Lakes are important to the future of Illinois. But, again, we can't do it alone.

Through the Illinois Department of Commerce and Community Affairs, we are working on what we call a Great Lakes marketing committee. We have had a problem, and it is that we all want the jobs created in our respective state. We all want cooperation, but as Bill Scott speaking this afternoon I was grinning to myself, because you know I feel for every other person in this country. But I'm in a mean business, and it's a jungle out there. I want the jobs to come to Illinois, as much as anybody else from any other state out there wants the jobs to come to their state.

But the first thing we have to do, before we do our sales pitch, especially overseas in Europe and Japan, we must build this Great Lakes region to be one that can be looked upon as almost a country. One that we can see has that essential quality of life and that marvelous water supply, as well as the ability to do business. We're going to continue working with the Great Lakes marketing committee to do that, but in the meantime, we're also going to pay a lot of attention at home here in Illinois.

Shipping is down, but that's picking up a little bit. We need a better marketing plan for this, and we need some help with federal regulations and all those things that I'm sure you've heard about so much in this conference. We need to do a lot in economic development and in tourism, a multi-billion dollar industry in this state. And thanks to our new $10 million kitty, we're going to develop that even more. We're going to talk about what Build Illinois can do for this state as far as helping with water problems.

We've got a great thing going. When it comes right down to it, people go to building their businesses and to work where they also have that gut reaction they get when they go someplace and it feels like the right place to raise a family. How many of us have stood at a window at the top of a corporate headquarters here in Chicago, or how many of us have driven down Lake Shore Drive early in the morning and felt that feeling that comes from being part of this marvelous shoreline? It's a tremendous asset to all of us in Illinois. We love it dearly as every speaker has said today.

But when you look out there and see that shoreline, protect it and develop it, because it means economic security to you as taxpayers of the State of Illinois.

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RECREATIONAL USE AND DEVELOPMENT OF SOUTHERN LAKE MICHIGAN

MICHAEL B. WITTE, DIRECTOR
ILLINOIS DEPARTMENT OF CONSERVATION

The diverse representation and talent at this conference is impressive, and clearly points to the significance of Lake Michigan and the impact it has on the Illinois economy, its people and, indeed, its quality of life. All of us in this room share a common responsibility to protect and nurture Lake Michigan as well as to capitalize on the existing and future opportunities it provides for us. I am excited and enthusiastic when I look at the potential Lake Michigan has to offer us in the future.

If we realize this potential, our success will be the result of strong partnerships -- partnerships with other agencies, other states, and increasingly more important, partnerships with our customers, citizens, constituency groups and local communities who share with us a common goal to provide quality outdoor recreation programs.

Conservation and recreation programs go far beyond providing opportunities for fishing, boating, camping and picnicing. They are intricately tied to managing resources upon which recreation opportunities can occur and be expanded, as well as tied to the economic vitality of communities, regions and the state as a whole. In my comments, I'll share with you some of our programs, successes and opportunities for the future, and how these relate to Illinois' recreational industry. (In Illinois alone, travel-related spending is over $6 billion and travel-related employment is approaching 130,000 jobs.)

Recreation boating access has been a major concern and priority of this agency and for the 7 million residents of the Chicago metropolitan area. Despite the fact that over 50 percent of Illinois' 63 miles of Lake Michigan shoreline is available for public use as open space and park land, many Illinois boaters must travel out of state to have access to, and to be able to store boats on Lake Michigan shores. Conservation is addressing this problem in two ways.

First, we have in place a Boat Access Assistance Program designed to provide 100 percent funding to local units of government for access to Illinois lakes and rivers. The boating fund derives its monies from boat registration and titling fees. The current allocation to the program is about $1 million annually.

To date, the Program has funded over $2.5 million in access grants and improvements to marinas along the Lake Michigan shores. These individual grants to communities and park districts alone may seem insignificant, but together they are a strong and positive step towards satisfying recreational demand and act as a catalyst for involving local communities in meeting our goals.

In addition to these annual grants, a recent change in law has resulted in a $2 million increase for funds to be allocated to the boating fund. Over the next 4 years, $2 million per year, for a total of $8 million, will be earmarked as one element of a major new initiative -- the new marina to be built at Illinois Beach State Park just south of the Wisconsin border. Thus, the Department of Conservation now has a second mechanism to provide boater access -- direct state involvement.

For nearly two decades, pressure has been intense for additional access and marina facilities on Lake Michigan. You heard yesterday from Governor Thompson that he has identified the marina as a top priority for funding this fall. Let me expand on some of the unique elements of this project.

It is a product of a public/private partnership which will result in expenditures of over $51 million. Through careful coordination with local communities and civic groups, a comprehensive development strategy has been formulated, a strategy that will make the marina financially self-supporting.

Once the marina is completed and fully operational, it will generate excess revenues at the rate of $3 million per year and by 1997 and 2003, the initial capital investment from the boating fund and the general revenue fund will be completely repaid. In addition, the project is estimated to generate excess revenues of over $28 million after its first 15 years of operation.

The new marina will satisfy a pent-up recreational demand which has been ignored for over 20 years. The state elements of the project include: a breakwater, basin, and a 1,500 slip marina; a 10-lane launch ramp and staging area; a slip with trailer and visitor parking; a harbor administration center and restrooms; and site amenities and utilities for boaters and non-boaters.

The private elements of the marina include: a marine center with 100 slips and a maintenance and repair building, a repair and storage yard, provisions and coffee shops, mobile lift and parking; restaurants and a yacht club; and a conference center with retail shops.

In addition to providing a major recreation asset, the marina will boost northeastern Illinois' economy significantly by creating 300 temporary construction jobs and more than 400 permanent jobs to operate the facility. Private investment at the marina will generate increased property taxes of $300,000 to $400,000 annually and sales taxes of $200,000 annually. Direct spending by marina users and visitors, excluding slip rental fees, is expected to exceed $10 million per year.

While the marina at Illinois Beach will go a long way to provide access and boating opportunities, it will not satisfy the overwhelming demand.

Local units of government will continue to strive for additional access. Conservation, through the Boat Access Grant Program, will be able to provide even more funds in the future. Funds formerly flowing to the new marina will

be available for direct grants for boat access purposes -- potentially $3 million annually will be available.

In addition, the Illinois Beach Marina will serve as an example for other units of government to follow -- public/private partnerships can work. And our work has already been cited by others as a model for future marina ventures.

Access and opportunity for recreational boating is only one responsibility of the Department. Equally important, if not more important, is the responsibility for the management, protection and enhancement of Lake Michigan itself. In this regard, our primary focus is the extraordinary Lake Michigan Fishery.

The fish population of Lake Michigan has changed dramatically over the past 50 years -- native species have declined and some have disappeared from the lake while other, recently introduced fish have flourished. The decline in native lake species has been mainly due to competition from introduced species such as the alewife, past over-harvest by commercial fishermen, parasitism by the sea lamprey, disease epidemics, changes in the environment of tributary streams, and the introduction of chemical contaminants.

This fishery decline, however, was sharply reversed during the late 1960s and early 1970s with the introduction of the coho and chinook salmon. That introduction had a dramatic impact on the sport fishery resource, turned the alewife problem into an opportunity, and created, almost instantly, an outstanding recreational resource having tremendous economic benefits. The Illinois portion of Lake Michigan alone provides 3.8 million sport fishing trips valued at over $90 million annually and commercial fish harvests valued at over $250,000 annually.

Our challenge, of course, is not only to protect this resource, but to manage it in such a manner as to ensure increased opportunities. Our management practices have been, and continue to be, dependent upon the cooperative efforts of other agencies and states as well as constituency groups. The following material highlights some of our more recent activities:

(1) Research - The Department, under contract with the Illinois Natural History Survey, began in April of this year a one-year survey of Lake Michigan anglers to measure fishing effort and success in the Illinois portion of the lake. This information is being gathered in a way that will enable us to describe the distribution of the angling efforts and catch by season, location and whether the angler was fishing from boat or shore. The data will assist in answering crucial questions regarding selection and numbers of species to be stocked, annual harvest and analysis of the benefits of our stocking programs.

(2) We have undertaken cooperative research with Salmon Unlimited in studying the growth and movement of rainbow trout in Lake Michigan. In addition, Salmon Unlimited made possible the stocking of 110,000

chinook salmon into Lake Michigan to offset an earlier loss of chinook at the Sand Ridge Hatchery.

(3) Almost 1 million fishes were stocked into the Illinois waters of Lake Michigan in 1985 including chinook salmon, coho salmon, lake trout, rainbow trout and brown trout. Most of these were raised at the Sand Ridge Hatchery that was recently completed. This hatchery, the most modern, sophisticated hatchery in the nation, has had only one year of full operation, and in 1984, produced over 25 million fish -- half the anticipated production capability. Illinois is now a full partner with other states in stocking Lake Michigan sport fish.

(4) Commercial fishing is presently restricted to only five crews by Department regulation. Our Conservation Law Enforcement Division monitors commercial fish markets, cold storage lockers, taxidermists and other commercial operations that are dependent upon Lake Michigan to ensure those programs are consistent with law, and managed to protect those precious resources. In addition, our law enforcement division has direct responsibility over recreational boating, sport fishing, 250 licensed charter boats, boat accident investigations, harbor patrol, and pollution investigations.

Future Directions

To guide the management and improvement of a quality Lake Michigan fishery, in 1986 the Department will publish its Strategic Plan for Fish in Lake Michigan. This plan is consistent with the comprehensive fisheries management plan being developed by the Lake Michigan Committee of the Great Lakes Fishery Commission. Illinois appreciates the important role this commission has played for the past 25 years in coordinating Lake Michigan-related activities.

The Illinois Lake Michigan Plan will identify strategies to control lamprey parasitism, including cooperative efforts to control lamprey populations in their Wisconsin and Michigan nursery streams; reduce the input of contaminants and toxic chemicals such as PCBs, DDT and Dieldrin; enhance lake-wide strategic management planning for all fish species of common concern through the Great Lakes Fishery Commission; utilize recent increases in Illinois' apportionment of federal Dingell-Johnson funds, through the Wallop-Breaux amendments, to implement a rigorous research program to provide life history and other information necessary to fine tune our long-range management programs; and develop increasingly accurate information on both sport and commercial fishing in Lake Michigan through continuation of monthly catch monitoring and periodic creel surveys.

A third element of our responsibility is the shoreline and the lakeside development which occurs on it.

As a state, we have been entrusted with an extremely significant, dramatic and delicate resource -- the shoreline of Lake Michigan. I'm confident all of us in this room share Governor Thompson's belief that protection and

erosion control is absolutely essential. It is also essential that action occur as quickly as possible because the quality of our existing and future lakeside opportunities are directly dependent on an immediate and vigorous shoreline protection effort. (Bill Jansen, Charles Collinson, ISGS)

The dominant Department effort to provide public shoreline access is obviously Illinois Beach State Park. Consisting of over 4 square miles of land and almost 6 miles of shoreline, it is significant for several reasons.

It is significant because it is the most heavily visited state park in Illinois -- over 2 million people annually visit Illinois Beach State Park. It also provides diverse recreational and nature study opportunities as well as serving as an economic stimulus to the local economy.

Conservation has recently embarked on the largest capital improvement program in the history of our state park system under two of Governor Thompson's new programs -- the Park and Conservation Improvement Program and the Build Illinois Program. These programs provide funds that will enhance Illinois Beach State Park by providing over $1.5 million to upgrade the facilities at Illinois Beach Lodge; $1.3 million to completely rehabilitate, upgrade and expand camping facilities at the park which have declined over the past 20 years; and the marina, with extensive shore development for both boaters and non-boaters who simply want to recreate in such an exciting and stimulating environment.

It is also significant because it contains the Illinois Beach Nature Preserve -- an 830-acre tract of land, the first of 136 dedicated nature preserves since 1963, and an irreplaceable resource of national significance. The nature preserve contains virtually the only remaining example of Lake Michigan beach and dune association in Illinois and serves as an environmental barometer as it contains a geologic record of Lake Michigan levels. It is, however, in danger of being lost as a result of the accelerating erosion.

Various shoreline protection alternatives have been implemented by local, state and federal agencies. Others have been proposed to protect the park and nature preserve -- all carry a high price tag.

Obviously, state land is not the only significant shoreline property -- extensive lands are held in public trust by virtually all the communities along the lakefront. Maximizing the use of these lands for public recreational opportunities has been in the past, and will continue to be, a state/local government partnership. As with boating access, DOC provides funding to local communities to encourage them to provide lakeshore access.

The Land and Water Conservation fund provides 50 percent funding of local recreation projects for open space acquisition and development. These funds are derived from federal off-shore mineral leases. To date, over $1.5 million, representing development of over $3 million, has been distributed to

park districts, cities and forest preserve districts for specific lake side development projects along the Lake Michigan shoreline.

The Open Space - Land Acquisition Development Program (OSLAD) was signed into law just a few months ago as a part of the Governor's Build Illinois Program. In fiscal year 1986, $4.6 million will be available to local units of government for 50 percent funding of park and recreation projects.

Within the next several months, Conservation will be reviewing and assessing grant applications from local units of government, and by next spring 50 percent of over $9.2 million worth of development will be funded. While there is no way to predict the outcome of those grant requests, lake access and waterfront development is a high priority of the agency.

Finally, no discussion of lakeshore access is complete without mentioning Navy Pier. It provides the opportunity to go beyond a state and local partnership by forming partnerships with federal agencies as well. Let me simply reiterate Governor Thompson's commitment of yesterday -- we stand ready to work with the city of Chicago, the National Park Service, or both, to restore the Pier to its former grandeur for the benefit of all citizens. There is no excuse for failure.

In conclusion, I would like to reinforce just a few points. The Illinois Department of Conservation is a full partner with all of you to protect, manage and enhance the opportunities which Lake Michigan offers. Lake Michigan is synonymous with quality of life, and Illinois' quality of life is directly linked to its economic vitality. Conservation programs, be they boating access to Lake Michigan, management of its fishery resource, or lakeshore protection and development, are indeed intricately linked to Illinois' quality of life and its economic redevelopment, not only along the shore, but across the state.

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WATER QUALITY PROTECTION IN THE FACE OF INCREASING DEVELOPMENT

DR. RICHARD CARLSON, DIRECTOR
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

What I want to do today is simply make a few observations on the environmental regulatory process both as it relates to Lake Michigan and as it relates to a lot of the other things that we do.

Initially, we should remind ourselves that over the last 15 years, through a variety of state and federal statutes, we have made a tremendous amount of progress in improving the quality of our environment and, as a result, the quality of our lives.

It's easy to forget in the rush to deal with toxics issues and all the other things that are enflaming sensibilities these days, that we have made an immense amount of progress since Earth Day 1970 toward controlling a variety of pollution problems.

Lake Michigan is a good example of that. Last year the State of Illinois, with its 49 sister states, went through a complex process of trying to determine exactly how much we've done in improving water quality in the United States.

As a regulator, I find one of the problems I have is demonstrating, through a very complicated kind of program, just exactly what we've done with the taxpayers' dollars. And when you get down to describing to people how we've improved 17 water quality parameters over 13,000 stream miles in the state of Illinois, it gets a little complicated trying to capture that in a way that people can understand.

Through the Association of State Water Pollution Program Managers, and with some funding from U.S. EPA, a fairly effective device was put together to do that, basically through the use of maps. In the process of developing those maps, we also developed some information on Lake Michigan which I believe underscores the point I'm making here.

In 1972, the baseline year for this study, the way we thought of water quality standards and the standard setting process was to figure out exactly what a water body would be used for, given its natural state, and then set water quality standards to protect those uses.

Those uses include a whole variety of human activities such as recreation, water supply, food processing and a host of others. But back in 1972, of the 63 miles of shoreline that we share with Lake Michigan, there wasn't a mile that wasn't suffering fairly severe use impairment. That is, the quality of the water was not up to the fairly tough standards that we hold for the lake.

By 1982, just ten years later, every one of those lake miles either fully or partially supported the uses to which the lake should be put.

If you look at the numerical standards and improvements over time, you'll notice a very positive trend because the slope is negative -- pollution is declining. (As regulators, we always confuse issues here, but it really is a positive trend because it's negative.) So, looking at the numerical standards and improvement over time, we've done a very good job improving the quality of the lake.

It wasn't an accident that this happened, because there have been conscious governmental policies to control pollution going into the lake. The one that I think is most illustrative is our policy on sewage treatment plants tributary to the Lake. To prevent discharges from entering Lake Michigan, we first upgraded facilities to bring them into compliance with effluent and water quality standards. Then we discharged this effluent to the inland water system, so that ultimately they end up in the Mississippi River, then go down to the Gulf of Mexico.

That's improved water quality in the lake and at the same time, through the use of some fairly sophisticated treatment processes, has improved the quality of the discharge that goes inland. I had my staff put together some numbers on that; over the last 15 years we spent about $76 million in federal construction grant monies and about $36 million in state monies to upgrade treatment plants and to implement this program aimed at eliminating direct discharges into Lake Michigan.

The basic problem that remains, and this involves the city and the Metropolitan Sanitary District, is the question of wet weather flow; when it rains, the combined sewer systems in the MSD service territory systems often overflow because the treatment plants can't handle the load. The tunnel and reservoir plan which is just beginning to come to fruition, should do much to reduce that problem in terms of discharges into Lake Michigan.

To move to a different view of lake quality, if you look at Lake Michigan fish advisories coming out over the last ten years, you will note declining levels in some of the things we're looking for, such as PCBs and DDT. The measurements here are small, but there seems to be a negative slope to that trendline, too. And in the business of environmental regulations, you look at trends: in any given year you're not probably going to accomplish anything terribly dramatic. (The hazardous waste cleanup program may be an exception to that generalization, but in terms of improving basic water quality or the quality of our air, program results tend to be long-term.) As a result, trends and incremental changes that are positive for the environment, all are causes for some gratitude.

Not everything is positive in terms of some traditional issues of upgrading municipal treatment systems and the like. The Clean Water Act is being reauthorized in Congress; a conference committee is about to begin work and the Great Lakes states may turn out to be losers because of some changes in the way federal monies will be allocated if the Senate version of the Clean

Water Act becomes law. At the instigation of the Sunbelt states, specifically Texas, the formula by which money goes to the states is being changed. Looking at all the projects from all the states that border the Great Lakes and the effect that change in the allocation formula would have over the next few years, a lot of projects probably will not be able to be built, or at least will be delayed, for lack of federal grant monies for projects which have been in the planning and design stages for years. Over the next few years we may transition to a different kind of grants program, which will primarily will be a loan program, but serious losses will occur in the meantime.

It appears Lake Michigan will be a big loser or potentially a big loser in terms of the clean water reauthorization debates now going on in Congress. And I can tell you that on the part of our agency, we've been vigorous in our attempts to lobby members of Congress to preserve as much as we can in terms of grant funds for sewage treatment plant projects and related efforts for the Great Lakes states and for the state of Illinois as well, although we are by far the least disadvantaged state in the region when it comes to that allocation change.

It's nice to be able to take pride in what you've done, and I think there's a lot to be proud of, a lot of progress to look back on. But it's quite clear that we're in a new era of challenge with regard to environmental regulation and environmental results. When (former Attorney General) Bill Scott started filing lawsuits back in the late 60s and early 70s, there was virtually no federal statutory law of any substance that dealt with environmental control. There was very little at the state level either, although that began to change in 1970 with the passage of the Illinois Environmental Protection Act. In the decade of the 70s there was an immense amount of activity in Congress and also at the state level to put in place the present regulatory system which is responsible for the results we see, in Lake Michigan and elsewhere.

In the 1960s, it was arguable that there were environmental problems out there. We might not have been able to characterize it in very sophisticated terms, or even needed to for that matter, but places like the Chicago River were polluted and we ought to clean it up -- that was an easy public policy goal to articulate and pursue. Now, we still have environmental problems, but you put your hand in some water bodies around the state and it comes out clean. You can't see the environmental challenges of the 1980s as clearly because they exist in parts per billion and they raise subtle health and environmental issues that are much more difficult to resolve because they're far more complex.

We have gotten to the point now where the next level of control is technically sophisticated, politically difficult and very expensive. It's comparatively easy to get rid of that first 90 to 95 percent; getting to 98 or 99 percent clean, and developing the rationale for moving that far with the attendant high cost, is the challenge that faces us now.

And today we're talking about residual chemicals with those funny names and those long molecular structures, and the issue isn't what's going to happen

today or tomorrow or even ten years from now; the issue is what happens to people who are exposed to very low levels of this stuff over a lifetime. We don't have any kind of actuarial history on which to rely, or any kind of good epidemiological studies which characterize the health effects involved. So we rely upon complicated, hard to understand, often highly controversial risk assessment models to guide the risk management decisions that regulators must make.

There is no social consensus on how to go about that risk assessment process, making it difficult for those on the spot, trying to answer questions, to seem to make any sense at all.

So while we have behind us 15 years of tremendous progress, we have before us an enormous political and technical challenge to deal with this new set of environmental issues.

That brings me to my concluding thought which is that we need to think about environmental regulation as being a lot more than regulation only. Regulation means we tell people what to do and how to do it in excruciating detail. For a presentation that I made a few weeks ago, I had my staff put together a photograph of what is is that we administer; we had four volumes of the Illinois Revised Statutes, we had two six-inch notebooks of agency regulations, we had the regulations of the Pollution Control Board and then six or seven volumes of the Code of Federal Regulations on a table which we had to reinforce to support the weight.

However, that system has served us well and I don't mean to malign it, but we need to start doing things in addition to the traditional regulatory approaches, to deal with the wide range of issues we're confronted with today.

People want to know about lifetime exposures at very low levels of chemicals, and we can't yet answer those questions very well.

They're concerned about quality of life, considerations that were never contemplated by the drafters of the Clean Water Act, the Clean Air Act, the Resource Conservation and Recovery Act, or the Illinois Environmental Protection Act. A lot of our problems at the agency originate in land use; you have incompatible activities stuck together and the only recourse people finally have is to deal with them as an environmental issue. We have noise problems, we have grain elevator problems where there is a lot of fugitive dust. There would be no problem if the land had been used a little more appropriately in the first place, if people weren't stuck so close together.

It's rather like the question of whether you can hear one hand clapping, or whether a tree falling in the forest makes a noise when there is nobody there to listen. There wouldn't be any problem if human activities that are essentially incompatible had never been forced together in a physical sense in the first place.

Take Southeast Chicago as an example. Some of the underlying issues are very much issues of land use, where you have people living in residential areas

which are proximate to some very unpleasant industrial activity. It's not very pleasant and it nothing that the Illinois Environmental Protection Act is geared to deal with.

I think Mayor Washington is to be given a great deal of credit, along with his staff, for trying to address this issue from an areawide perspective, looking at the totality of issues that are there, not just the strictly environmental issues.

The tools we as regulators have to deal with are just too limited. That was the conclusion of a two and a half year study we did -- that as an agency we couldn't do very much about a lot of issues that were coming up.

So we commend the city and the Mayor for pursuing them.

Someone spoke earlier about waste reduction. I am convinced that to embellish the regulatory system we need to do things in areas like that, which will complement our way of kind of "bossing" people around and working through a complicated and resource-intensive system to achieve environmental results.

I am absolutely convinced there is just a lot more we can do in the area of reducing waste generation and disposal. We used to have a section in our Land Pollution Division called "residuals management" which is our bureaucratic euphemism for society's garbage. As a society we do a lot of things, we make things, we use things, and there are residuals. There are leftovers. And those are not necessarily all things that ought to be thrown out. Some of those things can be used again. The more I see of the solid waste area the more I am convinced that we can do a lot outside the regulatory system to encourage the kinds of activities that take wastes which otherwise have to go through this complicated regulatory process and serve no useful social function and use them instead as resources, to use them as raw materials.

We've had a very positive experience with our Industrial Materials Exchange Service which we run in cooperation with the state Chamber of Commerce; we list industrial waste products every month and allow people to buy them as products. It happens often enough to suggest to me that if we were to push that activity a bit more, we could get a lot more payoff. I believe we ought to look at it in a much broader context, to do more and more of that kind of thing.

So, the challenge for Lake Michigan is a lot more complicated that it was in 1970, but as far as the Illinois EPA is concerned, we'll be giving it as much commitment and as much attention in 1985 as we did in 1970. It's just going to be harder work to do.

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CONSIDERING THE PAST IN PLANNING FOR THE FUTURE: THE CALUMET HARBOR EXAMPLE

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Introduction

Few areas provide a better example of the need to consider past land-use activities when planning for the future than Calumet Harbor (Figure 1). For more than a century, elaborate proposals for transforming this wetland adjacent to Lake Michigan into a major inland port have been advanced. The earliest planners had to contend with only an inhospitable natural setting, but today's developers must deal with relics of past projects as well as the marsh. The obvious elements of prior development include the survey system and land holdings, outdated street and rail networks, and abandoned or antiquated structures, yet these are normal obstacles to change. The less apparent dimensions are perhaps the most crucial here. Tons of industrial waste litter the landscape in the Calumet region, and until the true composition of the waste heaps is known, developers must proceed with great caution.

The first effective efforts to transform the Calumet area fell between the years 1869 and 1920. Much of this period is included in the Progressive Era, a time of rapid urbanization and meteoric industrial expansion. It was also a time of urban reform as professional planners made their debut, but planning had little impact on industrial areas. Public health officials pushed for comprehensive sewer systems to remove domestic sewage from the growing cities and planners touted the advantages of parks, civic beautification and improved transportation facilities. Their lofty ideas, however, failed to reach the satellite industrial communities growing at the fringe of most major cities.

The Calumet area is one such industrial zone. Situated 12 miles south of the Loop, it was initially singled out as an ideal development tract because Lake Michigan freighters could unload there. Through the years, a host of designs have been prepared to take advantage of the Great Lakes' transportation potential. Although industry thrived in the area, the extent of development never match the overly-optimistic vision of local boosters. The impact of industry on the area is pervasive, nevertheless. I would like to trace the history of industrial development in the Calumet area, giving special attention to the failure of previous plans to give adequate consideration to the environmental circumstances of the area or to the consequences of prior development.

Early Plans, 1869-1920

In 1869 the U.S. Congress funded the first modification of Calumet Harbor. Consenting to requests made by local boosters, and against the recommendation of the Army Engineers, federal legislators allocated $50,000 to cut through a bar at the mouth of the river and to erect piers out into Lake Michigan (Larson, p. 118). The plans called for dredging a navigable channel to the mouth of Lake Calumet so that deep-draft ships could call on industries forecast to line the river's banks. One wishful-thinking cartographer even showed Lake Calumet reshaped into a harbor. His vision never materialized, and an anticipated rise in property value came slowly (Hoyt, p. 109).

Delays in development lay partly in the physical realities of the area. Excellent rail connections linked the Calumet Harbor with East Coast markets, and lake freighters could deliver raw materials with relative ease; however, there was little solid ground for construction sites. Most of the area is low-lying marsh underlain by lacustrine clays (Figure 2). A slight gradient formerly allowed shallow Lake Calumet and surrounding plains to drain into Lake Michigan via the Calumet River system, although standing water covered much of the area. Such conditions restricted initial construction to the narrow sand ridges, remnants of barrier islands formed in the glacial-era Lake Chicago. Expansion out from these sites proceeded on spoil dredged from the riverbed. Both the Army Engineers and private companies "artificially raised" the river-front lots, systematically decreasing the area of the marsh.

This was a protracted undertaking, but as more and more industries arrived in the area, and as production increased, the pace quickened. Much of the intensified tempo was made possible by the vast quantities of industrial wastes generated. A portion of the wastes was dumped into the waterways. In 1895 the Chicago commander of the Army Engineers complained that "What goes into it [the Grand Calumet River] stays for lack of current to carry it off. Several towns and some great filth-producing manufacturing establishments have filled the dredge channels with filth as fast as excavated..." (U.S. Army, 1895, p. 2591). Eventually the accumulated sediments were dredged and relocated to the spoil banks along the river. Huge quantities of solid wastes were dumped directly on land and in water. Slag proved an ideal material for fill and provided a foundation for industrial expansion. "In the year 1878 and 1879 [the North Chicago Rolling Mill] commenced to deposit systematically, great quantities of slag and refuse from their mills, on the shore and in the lake along it[,] thereby artificially increasing the natural advantage of the shore line" (U.S. Congress, 1882, p. 3). Eventually they and other companies built several hundred acres of new land in Lake Michigan at the mouth of the Calumet River. Encroachments on the marsh also were common throughout the Calumet area. The town of Pullman was built on dredge spoil from Lake Calumet during the early 1880s. The foundation for this model town was harmless lacustrine clays, but for several years waste from the town and its industries were pumped to a "sewage farm" in the nearby marsh. After the waste disposal system began to encounter difficulties around 1887, most went into Lake Calumet ("Sewage," p. 27).

The methods employed in disposing industrial wastes exemplified the lack of comprehensive planning. Industrial planners were obsessed with the efficient movement of raw materials from the docks, through the works and to the railroad loading area. Small-scale planning was necessary for a successful operation, but attention was seldom directed beyond the assembly lines. Waste was a necessary nuisance that could be used to fill low ground, but was not worthy of costly treatment or careful planning--unless it meant a profit.

Yet even before 1920, the impacts of uncoordinated planning and reckless disposal of waste hampered industrial activity and affected workers and nearby residents. Inadequate funds frustrated Pullman's desire to open Lake Calumet to deep-draft shipping, and the eventual release of sewage into the lake further deterred opening a channel across it. Uncontrolled disposal of wastes in the Grand Calumet negated attempts to make that river navigable, and detracted from industrial growth along its course.

In addition, citizens and politicians lodged numerous complaints about pollution of Lake Michigan and the Calumet waterways. The annual release of approximately 59 tons of phenols and 25 tons of cyanide (Colten, p. 30)--along with other less toxic wastes--tainted the taste of Chicago's drinking water and made bathing in the lake unpleasant, if not impossible (Lee, p. 6). The nuisance caused by industrial wastes forced city officials to adopt a matter that rightfully should have fallen within the scope of industrial planners.

Planning for Public Health, 1921-1948

Reaction to the contamination of drinking water supplies was determined, if not swift. The Chicago Metropolitan Sanitary District initiated construction of the Cal-Sag Channel in 1907, although legal questions delayed its opening until 1921. Designed to divert Lake Michigan water through the Calumet River system, the canal would reverse the flow of the stream and flush industrial wastes into the Sanitary and Ship Canal (Cain, pp. 84-106). In addition, the following year they put into operation a sewage treatment plant south of Pullman. These massive projects represented a solitary effort by the Sanitary District to deal with the growing problem of industrial waste.

Due to insufficient planning coordination with manufacturers, the MSD's engineering approach failed to halt the contamination of drinking water. Wastes from iron and steel manufacturers continued to escape into Lake Michigan from the mouth of the Calumet River. Caused by excessive runoff from heavy rains, the situation was not constant but it did give rise to concern.

In an effort to assess the persistent industrial waste problem, the Sanitary District monitored factory discharges in 1924. They determined that 109 of the 123 manufacturers in the area were not connected to the sewage treatment facilities, and from this number some 7.4 million gallons of liquid wastes entered the Calumet River annually (Crouhurst, p. 10). Solids saturated with oils and other toxic materials also settled out in the streambed. Accumulations of these sediments were dredged by the Army Engineers and transferred

to Lake Michigan. Realizing they might be continuing to pollute water supplies, the Engineers in 1924 designated a disposal area well beyond the water intakes (U.S. Army, 1968).

The Illinois legislature also entered the water quality controversy and passed legislation in 1927 giving the MSD authority to "control and regulate the discharge of industrial wastes" (MSD, 1930, p. 59). This forced the few industries that were linked to the MSD system to provide primary treatment and they generally complied. Sherwin-Williams experimented with neutralization of wastes, although eventually they opted for the simpler dilution method (MSD, 1930, pp. 54-55). They constructed a holding tank for effluents, and regulated their release to avoid over-burdening the treatment works. Three other firms that were located along the Calumet River and producing hazardous wastes also employed holding tanks or ponds (Gorman, p. 519). They could halt direct discharge to the river when the flow was toward Lake Michigan, or flush their tanks when conditions were favorable. The volume of waste, however, was not reduced significantly until the economy slowed during the Great Depression. Estimates suggest that at the peak of prosperity during the 1920s, 100 tons of combined cyanide and phenols were released annually in the area and another 500,000 tons of solid wastes were dumped (Colten, p. 50). These solids most frequently were discarded in the marsh, and one contemporary observer suggested this method was an ideal means for reclaiming low ground (Appleton, p. 80).

While the MSD grappled with controlling industrial pollution, port planners unveiled a formal proposal for a massive inland port in Lake Calumet. Similar in many respects to designs offered during the 1880s and early 1900s, the plan showed the lake reshaped into a deep-water channel with a dozen slips built into the lake, using dredge spoil as fill. Offering to create 1,400 useful acres of land, its designers hailed it as the answer to Chicago's "pressing" need for industrial space (Chicago Committee on Harbors, 1920). Although the detailed drawing of the plan included roadways and rail links, it showed no sewer lines. It is apparent that industrial wastes were to be discharged into the harbor and for solids to be heaped up in the surrounding marsh as was customary at the time.

Granted, up until the early 1930s, public health officials considered certain industrial wastes as germicides, and therefore safe. However, a growing literature on the effects of industrial wastes and new techniques for waste treatment came into existence during the Depression (Tarr, pp. 1064-64). In spite of a major shift in the perception of wastes, factory managers continued to employ "up the chimney and down the river" methods of dispoal. This reflected the continuing internal planning focus of industrial managers even though the effects of their operations spread far beyond the factory gates.

Recent Plans, 1940-Present

Industrial wastes have continued to be a problem up through the most recent set of plans offered for the Calumet area. Only during the last decade and a half have public officials given them priority treatment.

The dumping of industrial wastes into the Calumet area waterways has long confounded the Corps of Engineers. Throughout much of the '30s and '40s their projects in the area had been reduced largely to maintenance of the navigable channel. Accumulations of iron fines and other suspended solids formed shoals in the sluggish Calumet River and obstructed the movement of the deep-draft lake vessels. Although the industries responsible for the offending discharges contributed to river maintenance through the 1940s, three major disposers refused to share the cost of dredging in 1953. Consequently, the Army initiated legal proceedings against International Harvester, Republic Steel, and Interlake Iron (U.S. Court of Appeals, 1957). In a case that proved to be a landmark decision, the Corps charged that the firms were violating the Refuse Act section of the Rivers and Harbors Act of 1899 (Crowdrey, 1975). This section forbade the dumping of "all foreign substances and pollutants" into navigable channels. The case rose to the U.S. Supreme Court where the majority ruled that accumulations of industrial solids were in fact obstacles to navigation under the 1899 law and that industrial discharges were within the definition of pollutants (U.S. Reports, 1960). This ruling forced the manufacturing establishments to seek permits prior to discharge, thus enabling the Corps to keep a record of dumping in the channel.

Even as the Corps' case against area industries worked its way through the courts, another plan for the Calumet area appeared (Chicago Regional Port District, 1953). It stressed the need for channel improvements and the removal of bridge obstructions across the Calumet River. No mention was made of industrial wastes or water quality.

The Sanitary District continued to face the issue largely on its own and during the last few decades has achieved major improvements. Beginning in the 1930s the MSD attempted to offer more waste treatment opportunities to area businesses, but by 1965, only coking wastes were receiving treatment at the southeast works (USHEW, p. 3). A report by the U.S. Department of Health, Education and Welfare in 1965 listed 43 companies in the Calumet region discharging wastes to area waterbodies. Many provided primary treatment, but large amounts of phenols, cyanide, and oils still entered the waterways (USHEW, Table VI-4a). A city plan offered two years later cited inadequate sewage service in the Calumet Lake district as a prime deterrent to future development there (Chicago Department of Development, 1967). Since 1970, most manufacturers have cooperated with the MSD to install treatment facilities, and water quality has improved. This suggests that, finally, waste disposal issues have penetrated the corporate planning process.

Land disposal of industrial wastes was another matter altogether, and after World War II, planners continued to see waste heaps as potential real estate. Beginning in 1940 over 300 acres of Lake Calumet were filled with municipal refuse, and in 1968, the Corps of Engineers began land interment of dredge spoil. Private operators now manage several of the Corps' disposal sites, and some claimed their operations would create prime industrial property. This activity has not made viable residential or industrial property, instead it has intruded on a natural area, reducing the size and security of a habitat for threatened species. Legal disposal has also encouraged less scrupulous waste handling in the area, and numerous illegal sites have already been discovered.

Conclusions

In closing, I concede that planners have used history to forecast continuing growth trends and to argue for positions embraced by developers. They have looked at previous plans for inspiration while sketching new versions, but they have not fully considered consequences of past projects. From the first phase of development in the Calumet area to the present, expectations have not been met. Army engineers complained in the 1980s that development lagged behind river improvements. The Van Vlissigen Plan was proposed in 1921 and again in a modified form in 1953. Still, Lake Calumet only vaguely resembles the form of the proposed harbor, and with the decline in industry in recent years, there is little hope that the original dream of an industry-lined lake will ever materialize. The inability of investors to achieve the scale of development found in the various plans is partly due to their over-enthusiasm, but the soggy footing of the Calumet marsh failed to support heavy industry.

In addition to ignoring a disappointing development record, planners, until recently, slighted the effects of industrial waste disposal. Those effects are too massive to avoid any longer. The long history of industrial waste disposal has created a landscape containing visible and invisible hazards. The visual impact of modern-day ziggurats (terraced pyramids) constructed of garbage will deter some investors, while the imperceptible dangers of illegally dumped toxic chemicals will exclude other development options. Thus, the Calumet's past intrudes on the present in a forceful and unappealing fashion. Careful assessment of the true extent and composition of waste accumulations must precede any future activity in the area, and this should not be limited just to known disposal sites or just southeast Chicago. Similar waste management strategies were followed throughout the Great Lakes region. Waterfronts and wetlands near industrial complexes in other Midwestern states experienced similar histories. As planners devise adaptive reuse strategies for old industrial districts, thorough accountings of past waste disposal practices must be an intrinsic part of the plan.

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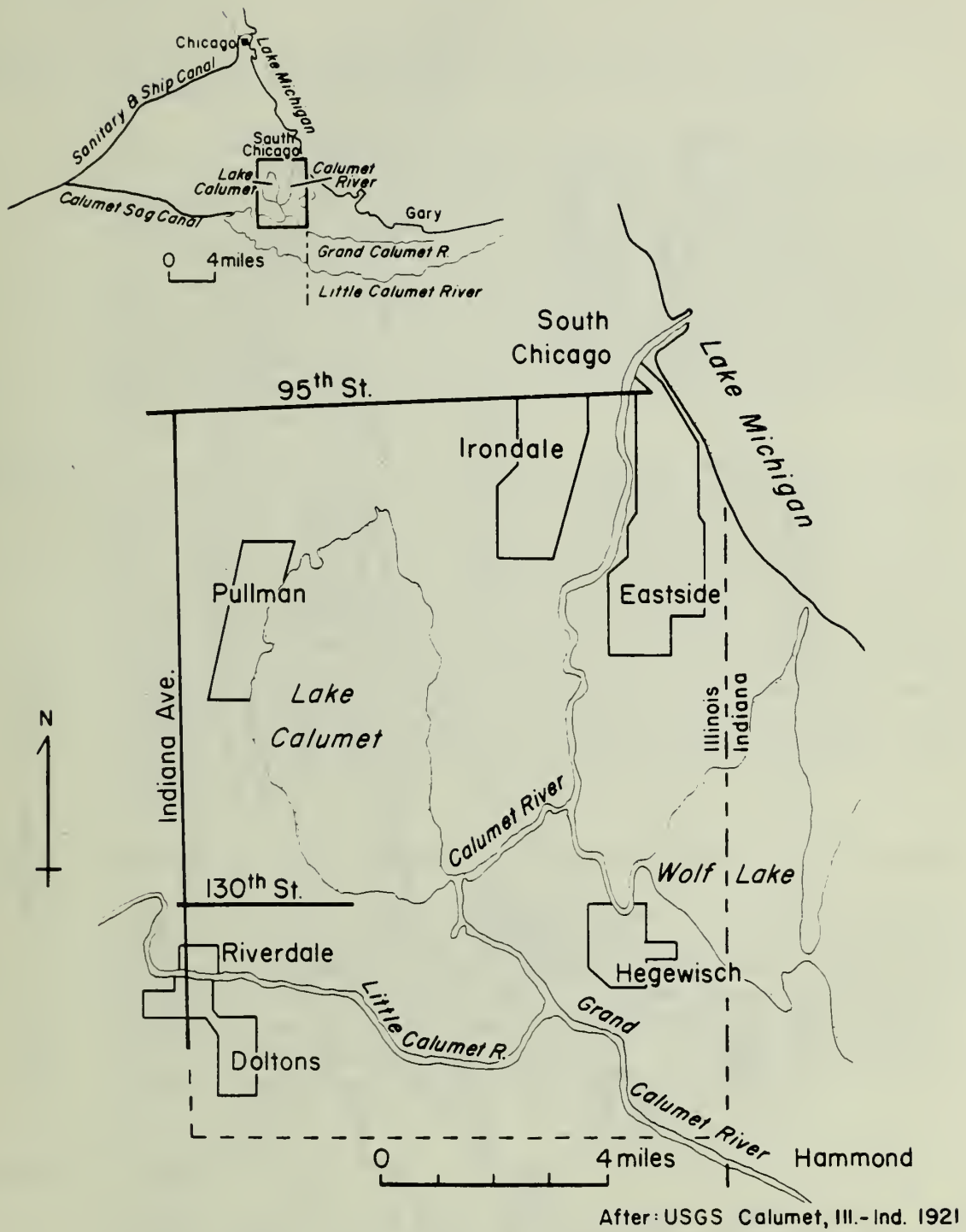

FIGURE 1. CALUMET HARBOR AREA.

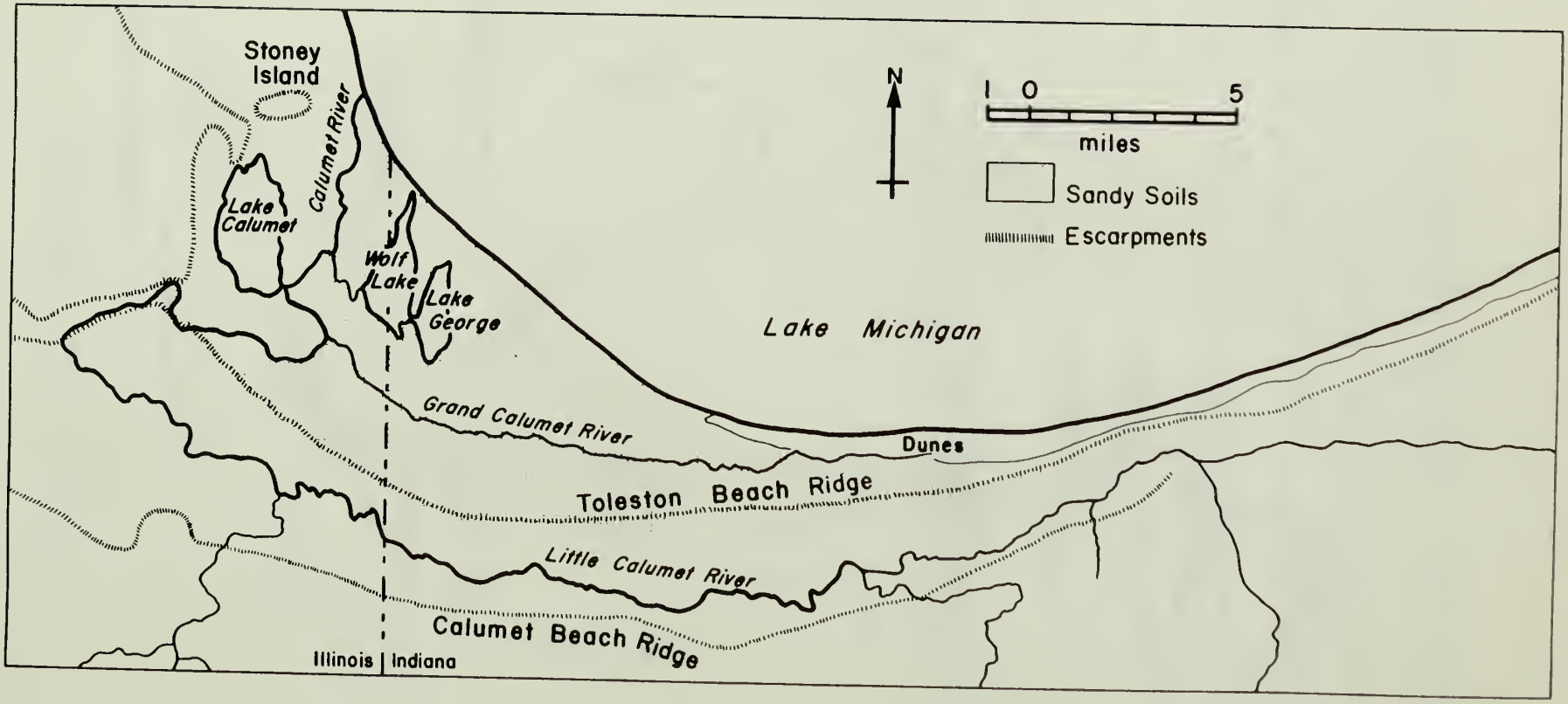

FIGURE 2. CALUMET AREA LANDFORMS.

QUESTIONS AND ANSWERS

ILLINOIS' LAKE RELATED POLICIES

Question: LEE BOTTS, Center for Urban Affairs and Policy Research, Northwestern University

I was going to ask this question of Rich Carlson because I noticed that he was careful to say that it appears that levels of toxic substances in fish tissues seem to be leveling off or declining. However, Doug Hallett and other scientists who were on the program yesterday have been pointing out that, while PCB levels seem to have leveled off since we are no longer manufacturing new PCBs, we are continually finding new toxic chemicals in the lake ecosystem. Is there any conflict between the state policy to produce and stock fish and the fact that those fish may not be suitable for human consumption? It seems to me that's one of the difficult issues that we have to confront.

Moderator: I think that's an excellent question, Lee. Perhaps Mike Witte could respond to it. I think you're right that there is some confusion on that subject, but my understanding is this year, 1985, was the first year that the Lake Michigan states agreed on a standard of toxics, but the major ones in fish. That was a significant agreement that will help the anglers know which fish, what size, and what kind of fish would be safe to eat. As long as the scientists say that they're safe within these guidelines, that's the best guideline you could go to. At the state level, we have a major fishery and are stocking fish. I think that the state's position would be as long as they're within those standards that the adjoining states have agreed to, they're safe to consume.

Answer: MICHAEL B. WITTE, Director, Illinois Department of Conservation

Rich Carlson noted that we have been making progress in the lake in terms of the levels of contaminants, and that's true. Part of the confusion arose, however, because the standards were changed. The change was from 5 to 2 PPM. So at the same time we were making progress in controlling contaminants, and the long-term trend has been downward in contaminant levels in the lake, the standard was changed for many contaminants from 5 parts per million to 2 parts per million.

Question: LEE BOTTS

No, that was only for PCBs. I haven't made myself clear. You're talking about the chemicals for which we have standards, and I'm referring to the fact that many scientists say there are many other chemicals for which we do not have standards at present; therefore, we're not measuring them. But the evidence shows that

they are accumulating in the ecosystem and in the fish. So, I think that this becomes an economic issue because the tourism which we are interested in promoting cannot be sustained if we continue to find, that not enough attention is being paid to the fact that there is a continued accumulation of toxics, which could undermine tourism, and the quality of life and all of those other things on which we're depending in order to maintain the economic base of the region. This is an important policy question which is really not getting the attention that it deserves at the present time.

Question: I've listened to two days of presentations on toxic wastes and all the money that is being spent on them, and I compliment the Department of Conservation on putting in a new 1700 or 1200 boat marina. Add it all up and you're going to get about 12,000 boats in the Illinois lakefront. You take 8 million people, that gives you about two tenths of a percent of the people of the collar counties allowed to be able to use this great resource we have. I would like to see the Governor's next conference bring in some social scientists and some people who are going to tell us how we're going to train city people to utilize this system that we've put bricks and mortar around and not been able to let them use it. In my particular business, the recreational boating business, I've seen all of my clients go over to Indiana, Michigan, and other places. They're the ones who have the money to move. What about our person down on the south side who doesn't have a job, doesn't have any place to go boating, and then you tell him he can't go boating because the water's too dirty, and yet when he's out on the Calumet River, he's boating in a sewer because that's the only thing he has, and he's finally decided it's worthwhile. So, what can we do to improve the quality of life for these 7 million people who can't use Lake Michigan because they don't have the money to do it?

Moderator: I think although you phrased it as a question, it's probably more a statement than anything else. It's clear that with the limited shoreline we have and limited lake access, we'll never be in a position to provide economic access to Lake Michigan for everyone in our state.

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These proceedings contain the papers of the presentors at the 14th Annual Conference held September 26 and 27, 1985 in Chicago. The Conference, entitled A GOVERNOR'S CONFERENCE ON LAKE MICHIGAN - ILLINOIS' GREAT LAKE: PROTECTING AND DEVELOPING A VALUABLE NATURAL RESOURCE, had over 300 participants and 31 speakers. Lake Michigan's role as a recreational, environmental, transportation and water resource for Illinois and other Great Lakes basin states was the major topic of the conference.

Issues discussed included Water Quality (e.g., contaminants, nutrients); Water Quantity(e.g., lake levels, diversions, erosion); Research and Policy Needs (e.g., agency needs, problems and prospects); Water and Land Use Development (e.g., recreation, jobs, CZM, and fisheries); and Lake Related Policies (e.g., government's role, history of region and water quality protection). The focus of the conference was the need to balance public and private demands on Lake Michigan's resources with the necessity for protecting environmental quality in the region.

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